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FOR THE

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INDEX TO HOUSE EXECUTIVE DOCUMENTS.

CONTENTS OF THE VOLUMES.

VOL. 1..FOREIGN RELATIONS: No. 1, pt. 1.
VOL. 2..WAR: No. 1, pt. 2, v. 1.
VOL. 3.. ENGINEERS: No. 1, pt. 2, v. 2, pt. 1.
VOL. 4.. ENGINEERS: No. 1, pt. 2, v. 2, pt. 2.
VOL. 5.. ENGINEERS: No. 1, pt. 2, v. 2, pt. 3.
VOL. 6.. ENGINEERS: No. 1, pt. 2, v. 2, pt. 4.
VOL. 7.. ORDNANCE: No. 1, pt. 2, v. 3.
VOL. 8.. SIGNAL OFFICER: No. 1, pt. 2, v. 4.
VOL. 9..NAVY: Parts 1 and 2, No. 1, pt. 3.
VOL. 10..POSTMASTER-GENERAL: No. 1, pt. 4.
VOL. 11..INTERIOR: No. 1, pt. 5, v. 1.
VOL. 12.. No. 1, pt. 5, v. 2.
VOL. 13.. No. 1, pt. 5, v. 3.
VOL. 14.. No. 1, pt. 5, v. 4.
VOL. 15.. No. 1, pt. 5, v. 5.
VOL. 16..No. 1, pt. 6.
VOL. 17..No. 2, pt. 1.
VOL. 18..No. 2, pt. 2.
VOL. 19..No. 3.
VOL. 20..Nos. 4 to 20, inclusive, except Nos. 5, 9, 18, and 19.
VOL. 21..Nos. 5, 62, 116, and 176.
VOL. 22..No. 9.
VOL. 23..No. 18.
VOL. 24..No. 19.
VOL. 25..Nos. 21 to 50, inclusive, except Nos. 27, 29 31, and 49.
VOL. 26..No. 27.
VOL. 27..Nos. 29 and 31.
VOL. 28..No. 49.
VOL. 29..No. 51.
VOL. 30..Nos. 52 to 118, inclusive, except Nos. 62 and 116.
VOL. 31..Nos. 119 to 172, inclusive, except No. 153.
VOL. 32..No. 153.
VOL. 33..Nos. 173 to 280, inclusive, except Nos. 176 and 253.
VOL. 34..No. 253.
VOL. 35..Nos. 281 to 377, inclusive, except No. 290.
VOL. 36..No. 290.
VOL. 37..No. 378.

INDEX TO THE DOCUMENTS.

Subjects.	No.	Vol.
A.		
Accounts, annual report of unsettled	36	25
report of Secretary of Treasury on balances due to and from Government on	363	35
Agriculture, annual report of Commissioner of, for 1885	378	37
Alaska, letter of Attorney-General relative to bond of United States marshal for	11	20
letter of Secretary of Treasury relative to accounts of secretary of	276	33
Alcoholic liquor traffic, letter of Secretary of Treasury relative to license tax on retail liquor dealers	107	30
American Graphic Company, report of Secretary of War on claim of	183	33
Anderson, Mary, message of President vetoing bill (H. R. 7436) to pension	322	35
Andrews, C. C., letter of Secretary of Treasury on reimbursement of	124	31
Animals. (*See* Cattle.)		
Appropriations, annual deficiency estimates	62	21
letter of Secretary of Treasury transmitting estimates for next fiscal year	5	21
supplemental estimates of	176	21
Arizona, letter of Secretary of Treasury relative to salary of surveyor-general of	106	30
Arkansas River, report of engineers on survey of	90	30
Army, annual report on expenditure of contingent fund of	77	30
appropriations for, letter of Secretary of War relative to	192	33

Subjects.	No.	Vol.
Army, Artillery School, letter of Secretary of War relative to erecting building for	171	31
letter of Secretary of War relative to pay of enlisted men employed at Artillery School	108	30
letter of Secretary of War relative to organization of light batteries	115	30
mileage, letter of Secretary of War relative to	134	31
Arner, Philip, message of President vetoing bill (H. R. 6266) to pension	324	35
Artillery School. (*See* Army, Fort Monroe.)		
Asheville, N. C., message of President vetoing bill (H. R. 5546) to erect public building at	367	35
Attorney-General:		
Communications from—		
Annual report	7	20
Alaska, relative to bond of marshal in	11	20
Attorneys-General, relative to vouchers for cost of portraits of	229	33
Department of Justice, relative to contingent fund of	224	33
reports on trust funds in	271	33
Fees, relative to payment of, for returning evidence taken by comsioners	24	25
Fox and Wisconsin Rivers, report on awards for damages by improvement of	207	33
Jurors and witnesses, asking deficiency appropriation for	59	30
Substitutes, relative to employment of	155	31
Symons, Thomas, relative to claim of	177	33
B.		
Balances. (*See* Accounts, War Department.)		
Bangham, Eleanor C., message of President vetoing bill (H. R. 1582) for relief of	251	33
Barnes, Rachel, message of President vetoing bill (H. R. 9106) to pension	369	35
Bartholdi Statue of Liberty, message of President relative to inaugurating	232	33
estimate of appropriation for inaugurating	249	33
Beard, W. H., report of Secretary of Treasury on claim of	241	33
Beezeley, Louisa C., message of President vetoing bill (H. R. 576) for relief of	302	35
Bishop, William, message of President vetoing bill (H. R. 6688) for relief of	320	35
Block Island, letter of Secretary of War relative to submarine cable at	197	33
Boisé City, Idaho, letter of Secretary of Treasury relative to enlarging United States penitentiary at	54	30
Bonaveris, Paul, estimate of appropriation to pay claim of	198	33
Boon, Clark, message of President vetoing bill (H. R. 7931) to increase pension of	317	35
Boone, William, message of President vetoing bill (H. R. 472) to pension	332	35
Bordeaux International Congress, letter of Secretary of State relative to	205	33
Boston, letter of Secretary of Treasury relative to payment of silver dollars at subtreasury at	163	31
Boston Harbor, letter of Secretary of War relative to repairing seawall in	136	31
Bradley, Sallie A., message of President vetoing bill (H. R. 5394) to pension	337	35
Brooklyn, N. Y., letter of Secretary of Treasury relative to increasing cost of public building at	129	31
Buffalo, N. Y., estimate of appropriation for repair of custom-house at	218	33
Bureau of Engraving and Printing, letter of Secretary of Treasury relative to improving building of	170	31
Bureau of Labor, estimates of appropriations for	69	30
Bureau of Ordnance. (*See* Navy Department.)		
Bureau of Statistics, annual report and statements of Chief of (foreign commerce)	19	24
Butter. (*See* Oleomargarine.)		

Subjects.	No.	Vol.
C.		
Cadwalader, J. F., letter of Secretary of Treasury relative to account of..	67	30
Cape Orford, Oregon, estimate of appropriation for light-station at.....	138	31
Capitol Grounds, letter of Secretary of Treasury relative to appropriation for improving.....	104	30
Carroll, James, message of President vetoing bill (H. R. 4642) to pension	351	35
Carson City, Nev., letter of Secretary of Treasury relative to appropriation for mint at.....	267	33
Cattle, consular reports on.....	51	29
Census, estimate of appropriation for.....	191	33
Central Pacific Railroad, estimate of appropriation to pay transportation claims of.....	270	33
estimates to pay for mail service.....	280	33
Chase, Charles A., message of President vetoing bill (H. R. 6372) to pension.....	300	35
Chinese immigration, message of President relative to.....	102	30
Civil Service, annual report of, Commission.....	140	31
letters relative to employment of substitutes from—		
Attorney-General.....	155	31
Postmaster-General.....	145	31
Secretary of Interior.....	168	31
Secretary of Navy.....	156	31
Secretary of State.....	160	31
Secretary of War.....	165	31
Secretary of Treasury.....	166	31
Claims, report of, allowed by Court of Claims.....	233	33
list of, allowed for which no appropriations made.....	210	33
estimate of appropriation for defending suits against United States for.....	211	33
report of Secretary of Treasury on, allowed.....	294	35
of claims allowed under exhausted appropriations.....	225	33
on claims allowed.....	70	30
report of Secretary of Treasury on war claims allowed under act of July 4, 1864.....	34	25
Clarksburg, W. Va.. message of President relative to appropriation for public building at.....	366	35
Coal, report of Secretary of Treasury relative to drawbacks on.....	201	33
Coast defenses. (*See* Fortifications.)		
Coast Survey, annual report.....	18	23
annual report of expenditures.....	32	25
Coins and coinage, letter of Secretary of Treasury relative to silver balances and silver circulation.....	64	30
letter of Secretary of Treasury relative to reissue of nickel and copper coins.....	174	33
estimate of appropriation for transportation of minor coin.....	247	33
estimate of appropriation for storage and transportation of silver dollars.....	142	31
report of Secretary of Treasury relative to circulation of silver dollars.....	100	30
report of Secretary of Treasury relative to payment of silver dollars at Boston subtreasury.....	163	31
Collectors of customs, report of Secretary of Treasury relative to suits against.....	148	31
Commerce and navigation, message of President relative to House bill 4838, to abolish certain shipping fees.....	277	33
report of Secretary of State on foreign mercantile marine.....	172	31
Commercial relations, consular reports on.....	253	34
Commissioner of Internal Revenue, annual report.....	4	20
Compagnie Générale Transatlantique, letter of Secretary of State relative to claim of.....	206	33
Comptroller of the Currency, annual report of.....	3	19

Subjects.	No.	Vol.
Connelly, Julia, message of President vetoing bill (H. R. 6257) for relief of	304	35
Consular and diplomatic service, estimate of appropriations for salaries of alien consuls	239	33
estimate for rental of buildings in Tokio, Japan	213	33
estimate of deficiency appropriation for salaries of chargés d'affaires	261	33
Consular reports, trade and commerce of foreign countries	253	34
on cattle	51	29
Copyright, diplomatic correspondence relative to international	354	35
Corwin (revenue steamer), report on cruise of 1885	153	32
Cotton, James D., message of President vetoing bill (H. R. 6117) to pension	311	35
Court of Claims, estimate of appropriations for judgments of	275	33
Courts of United States, letter of Attorney-General asking deficiency appropriation for jurors and witnesses	59	30
letter of Attorney-General relative to payment of fees for returning evidence taken before commissioners	24	25
estimate of deficiency appropriations to pay witness and juror fees	244	33
appropriations for, additional estimates of	173	33
	184	33
	204	33
Cree Indians. (*See* Indians.)		
Crooks, James, report of Secretary of State on claim of	161	31
Crow Indians. (*See* Indians.)		
Cunningham, Maria, message of President vetoing bill (H. R. 5414) to pension	345	35
Customs. (*See* Import duties.)		
Customs cases, annual report of awards to informers in	14	20
Customs districts, report of Secretary of Treasury on non-paying	238	33
	246	33
Customs officers, annual report on emoluments of	56	30
Cutter, G. W., message of President vetoing bill (H. R. 3551) to pension	376	35
Cutting, A. K., message of President relative to arrest in Mexico of	371	35
D.		
Darling, James H., message of President vetoing bill (H. R. 7257) to pension	306	35
Debt of United States, report of Secretary of Treasury on sinking fund for	66	30
letter of Secretary of Treasury relative to destruction of mutilated securities	167	31
report from 1791 to 1885 on	116	21
Deming, Francis, message of President vetoing bill (H. R. 2971) to pension	350	35
Denver and New Orleans Railroad, letter of Secretary of Interior relative to discriminations against	186	33
Department of Justice, report of Attorney-General on trust funds in	271	33
estimate for fitting up building for	189	33
letter of Attorney-General relative to contingent fund of	224	33
supplemental estimates of appropriations for	173	33
Department of State, annual report on expenditures of	12	20
annual report on clerks in	52	30
estimate of appropriation for printing and binding for	86	30
Deputy Comptroller of Currency, letter of Secretary relative to salary of	103	30
Dermody, William, message of President vetoing bill (H. R. 1505) to pension	353	35
Direct tax of 1861, report of Secretary of Treasury on	158	31

Subjects.	No.	Vol.
District of Columbia, estimates of appropriations for schools in	84	30
estimate of appropriations for education of feeble-minded children in	80	30
letter of Secretary of War relative to appropriations for water supply in	39	25
appropriations for, estimates for public-school building public parks in, letter of Secretary of War relative to regulations for	223 144	33 31
Dow, Jennette, message of President vetoing bill (H. R. 3363) to pension	367	35
Duluth, Minn., message of President vetoing bill (H. R. 5550) to erect public building at	340	35
E.		
Eight-hour law. (*See* Postal service.)		
Elderkin, David T., message of President vetoing bill (H. R. 5995) to pension	312	35
Eldridge, Rebecca, message of President vetoing bill (H. R. 2145) for relief of	250	33
Evans, Fannie E., message of President vetoing bill (H. R. 4426) to pension	339	35
Ex-Attorneys-General, letter of Attorney-General relative to vouchers for cost of portraits of	229	33
Executive Departments, letters relative to employment of substitutes in, from—		
Attorney-General	155	31
Postmaster-General	145	31
Secretary of Interior	168	31
Secretary of Navy	156	31
Secretary of State	160	31
Secretary of Treasury	166	31
Secretary of War	165	31
F.		
Farris, J. W., message of President vetoing bill (H. R. 6136) to pension	285	35
First Comptroller of the Treasury, annual report of unsettled accounts.	36	25
report of	27	26
Forbes, Duncan, message of President vetoing bill (H. R. 8336) to increase pension of	370	35
Foreign mercantile marine, report of Secretary of State on	172	31
Fort Brady, report of Secretary of War relative to sale of	81	30
Fort Douglas, estimate to enlarge	112	30
Fort Hamilton, estimate of appropriation for purchase of ground at	216	33
Fort Leavenworth, estimate of appropriation for building at	178	33
report of Secretary of War on encroachments of Missouri River on reservation at	121	31
Fort Monroe, Va., plans and estimates for permanent wharf at	28	25
letter of Secretary of War relative to erecting building for artillery school at	171	31
Fort Niagara, estimate of appropriation for protecting site of	292	35
Fort Porter, estimate for rebuilding	130	31
Fortifications, letter of Secretary of Treasury relative to appropriations for armament	259	33
Fourth of July claims. (*See* Claims.)		
Fox and Wisconsin Rivers, report of Attorney-General on awards for damages by improvements of	207	33
Freedman's Hospital, D. C., estimate for repairing water-tank at	88	30
French spoliation claims, estimate of appropriation for securing evidence in	266	33
French spoliation claims, report of Secretary of State on	194	33

Subjects.	No.	Vol.
G.		
Galveston Harbor, report of engineers on improvement of	85	30
Gold and silver, annual report of Director of Mint on production of	290	36
Gondalfo, Cæsar, report of Secretary of Treasury on claim of	74	30
Governor's Island, N. Y., letter of Secretary of Treasury relative to beacon light on	159	31
Grand Island, Miss., estimate for light-house on	137	31
Gray's Harbor, Wash. Ter., letter of Secretary of Treasury relative to additional appropriations for light-house at	98	30
Great Falls. (*See* Potomac River.)		
Green and Barren Navigation Company, letter of Secretary of War relative to purchasing franchises of	152	31
Grosse Island, Mich., letter of Secretary of Treasury relative to establishing range lights at	265	33
Guyse, George W., message of President vetoing bill (H. R. 3205) to pension	310	35
H.		
Hall of Records, letter of Secretary of Treasury relative to erecting	143	31
Hannibal, Mo., letter of Secretary of Treasury on increasing cost of public building at	150	31
Hanson Grant, Florida, report of Secretary of Interior on	331	35
Harbaugh, Sarah, message of President vetoing bill (H. R. 6895) to pension	315	35
Harden, S. W., message of President vetoing bill (H. R. 1406) to pension	252	33
Harrington, Edward M., message of President vetoing bill (H. R. 6648) to pension	336	35
Hawes, Susan, message of President vetoing bill (H. R. 7234) to pension	374	35
Hawley, Giles C., message of President vetoing bill (H. R. 424) to pension	305	35
Hendricks, Thomas A., estimate of appropriation for engraved portraits of	151	31
Hennepin Canal. (*See* Illinois and Mississippi Canal.)		
Hensley, E. P., message of President vetoing bill (H. R. 1707) to pension	289	35
Hill, Andrew J., message of President vetoing bill (H. R. 1471) to increase pension of	226	33
Hipple, Henry, message of President vetoing bill (H. R. 6897) to pension	284	35
Holland, report of Secretary of State on taxation of petroleum by	179 254	33 33
Hot Springs, Ark., estimate of appropriations for improvements at	212	33
letter of Secretary of War relative to Army and Navy hospital at	296	35
Humboldt Bay, California, report of Secretary of Treasury relative to removing light-house at	91	30
Hunter, John, message of President vetoing bill (H. R. 1990) to pension	282	35
Hunter, Maria, message of President vetoing bill (H. R. 7167) for relief of	327	35
I.		
Illinois and Mississippi Canal, report of engineers on surveys of routes for	117	30
Immigration, letter of Secretary of Treasury relative to regulation of	141	31
Import duties, annual report on refunds of	16	20
annual report of Secretary of Treasury on expenses of collecting	33	25
letter of Secretary of Treasury relative to revision of laws regulating protests, appeals, and suits for collection at	43	25
letter of Secretary of Treasury relative to revision of	147	31
report of Secretary of Treasury on questions arising under tariff act of 1883	68	30
report of Secretary of Treasury relative to drawbacks on coal	201	33

Subjects.	No.	Vol.
Indian Bureau, estimate of appropriation for clerical force in	89	30
Indian Commissioners, annual report	109	30
Indian depredation claims, report of Secretary of Interior on	125	31
Indians:		
census of, estimate of appropriations for taking	79	30
Cheyenne, message of President relative to condition of	17	20
Cree, estimate for relief of	231	33
Crow, letter from Secretary of Treasury relative to appropriation for allotment of lands to	53	30
Mackinac Agency, estimate for compensation of agent at	234	33
Mescalero Reservation, letter of Secretary of Interior relative to paying settlers for improvements on	221	33
Miami, letter of Secretary of Interior relative to relief of	57	30
letter of Secretary of Interior relative to funds of	23	30
Navajo Reservation, estimate of appropriation for artesian wells on	263	33
Round Valley Agency, estimate of appropriations for	295	35
Reservation, report of Secretary of Interior on allotting lands of	21	25
Sioux, estimate to pay claims of Red Cloud and Red Leaf bands of	35	25
Indian service, report of expenses and disbursements in	6	20
Interior Department, annual report of contingent expenditures of	15	20
estimate for constructing east wing of building of	230	33
Internal Revenue, Annual Report of Commissioner of	4	20
letter of Secretary of Treasury relative to paying drawbacks on stills exported	46	25
taxes, letter of Secretary of Treasury relative to license-tax on retail liquor-dealers	107	30
collectors, relative to repealing commissions to	122	31
letter of Secretary of Treasury relative to commissions to	122 190	31 33
laws, letter of Secretary of Treasury relative to penalties for having in possession used liquor-stamps	194	33
International copyright. (*See* Copyright.)		
Iron and steel tests, estimate of appropriations for	73	30
Irwin, John T., message of President vetoing bill (H. R. 3640) to pension	338	35
J.		
Jacoby, Margaret A., message of President vetoing bill (H. R. 5021) to pension	344	35
Jeffersonville, Indiana, estimate of appropriation to purchase land at	178	33
Joseph Richards, letter of Secretary of Interior relative to accounts of	127	31
Jurors. (*See* Courts of United States.)		
K.		
Kansas City, Fort Scott and Gulf Railroad, message of President returning bill (H. R. 6391) granting right of way to	255	33
Karstetter, Mary, message of President vetoing bill (H. R. 2043) to pension	341	35
Kinney, Ann, message of President vetoing bill (H. R. 5389) to pension	375	35
Kyler, H. L., message of President vetoing bill (H. R. 1818) to pension	334	35
L.		
La Abra Mining Company, report of Secretary of State on claim of	274	33
Lancaster, R. D., letter of Secretary of Treasury relative to charges against	360	35
Leavenworth Military Prison, letter of Secretary of War relative to application of appropriations for	200	33
Leefe, F. J., message of President vetoing bill (H. R. 3624) to pension	283	35
Legaré, Jean Louis, letter of Secretary of State relative to claim of	356	35

Subjects.	No.	Vol.
Lehman, L., report of Secretary of Treasury on reappraisement of glass-ware imported by	22	25
Letter-carriers. (*See* Postal Service.)		
Lights, letter of Secretary of Treasury relative to appropriation for depot for fourteenth light-house district	40	25
Grand Island, Miss., estimate for light-house on	137	31
Gray's Harbor, Washington, letter of Secretary of Treasury relative to additional appropriation for light-house at	98	30
Governor's Island, New York, letter of Secretary of Treasury relative to beacon-light on	159	31
Grosse Island, Michigan, letter of Secretary of Treasury relative to establishing range-lights at	265	33
light-houses, estimate of appropriations for repair of	269	33
Pensacola, Fla., letter of Secretary of Treasury relative to additional, at	45	30
Two Harbors, Minn., estimate for light station at	203	33
Liquor dealers. (*See* Alcoholic liquor traffic.)		
Loomis, Aretus F., message of President vetoing bill (H. R. 7018) to pension	333	35
Lord Nelson (schooner), letter of Secretary of State on claim of	161	31
Luce, Elizabeth, message of President vetoing bill (H. R. 5997) to pension	281	35
M.		
McCarty, Catharine, message of President vetoing bill (H. R. 5603) to pension	335	35
McIlwain, Martha, message of President vetoing bill (H. R. 7162) to pension	318	35
McKay, Elizabeth, message of President vetoing bill (H. R. 4782) to pension	347	35
Mackinac Agency. (*See* Indians.)		
Mare Island navy-yard, estimate of appropriations for quarters and barracks at	279	33
Marine Corps, additional estimate of appropriations for	202	33
Marine Hospital Service, letter of Secretary of Treasury relative to an additional surgeon-general in	187	33
estimate of appropriation for repair of hospitals	217	33
Medical examiners. (*See* Pension Office.)		
Merchant marine. (*See* Commerce and navigation.)		
Mescalero Reservation. (*See* Indians.)		
Mexican awards, report of Secretary of State on claims of La Abra Mining Company and B. Weil under	274	33
Miami. (*See* Indians.)		
Military Academy, estimate of appropriations for	119	31
letter of Secretary of War relative to appropriation for	135	31
Milk sugar, letter of Secretary of State on manufacture in Switzerland of	188	33
Miller, Mary Ann, message of President vetoing bill (H. R. 1816) to pension	309	35
Miller, Samuel, message of President vetoing bill (H.R. 7401) to pension	316	35
Mint, annual report of Director of Mint on production of precious metals	290	36
estimate of appropriation for boilers at Philadelphia mint	273	33
letter of Secretary of Treasury relative to appropriation for	87	30
letter of Secretary of Treasury relative to salaries of officers of	126	31
letter of Secretary of Treasury relative to appropriation for mint Carson City, Nev	267	33
Mississippi River, letter of Secretary of War relative to regulations for passage of vessels through, South Pass of	58	30
letter of Secretary of War relative to appropriations for continuing examinations of South Pass of	75	30
Mississippi River Commission, supplemental report of	38	30
Missouri River Commission, report of	41	30
Monroe, J. D., message of President vetoing bill (H. R. 4058) to pension	286	35
Montana, estimate of appropriations for legislative expenses of	123	31

Subjects.	No.	Vol.
Moorehead, Abner, message of President vetoing bill (H. R.3304) to pension	346	35
Muskingum River, report of engineers on survey of	48	25
Mutual Life Insurance Company, N. Y., letter of Secretary of Treasury relative to claim of	235	33
N.		
National Museum, estimate of appropriations for	291	35
Navajo Reservation. (*See* Indians.)		
Navy, list of retired officers	111	30
vessels, estimate of appropriation for armament of new cruisers	215	33
report of Secretary of Navy relative to progress on steel cruisers	185	33
Navy Department, annual report of contingent expenses of	47	25
annual report of employés in	65	30
estimate to pay carpenters at	242	33
estimate for pay of draftsmen in Bureau of Steam-Engineering	243	33
estimate of deficiency appropriation for Bureau of Ordnance	195	33
Navy-yard, Mare Island, estimate of appropriations for quarters and barracks at	279	33
Neptune Island, New York, estimate of appropriation to purchase land at	178	33
Nevil, William H., message of President vetoing bill (H. R. 3623) to pension	349	35
New Mexico, letter of Secretary of Interior relative to adjusting private land claims in	209	33
New Orleans, La., estimate of appropriation for repairs of mint building at	218	33
report of Secretary of Treasury on moneys and funds seized by military authorities at	101	30
New York City, report of Secretary of War on purchase of Produce Exchange in	13	20
estimate of appropriation for an assistant collector at	240	33
letter of Secretary of Treasury relative to additional accommodations for appraiser's store at	94	30
estimate of appropriation for repairing barge office at	220	33
letter of Secretary of Treasury relative to sale of old post-office in	235	33
estimates of appropriation for sub-treasury at	180	33
Norfolk navy-yard, report of Secretary of Navy on affairs at	118	30
Norman, Mary, message of President vetoing bill (H. R. 6192) to pension	325	35
O.		
Olcott Harbor, New York, estimate for repairs at	228	33
Oleomargarine, message of President relative to bill to define butter and to tax	368	35
Oregon, report of Secretary of Interior on wagon-road land grants in	131	31
Onnalaska (schooner), report of Secretary of State on case of	329	35
P.		
Pacific Railroads, letter of Secretary of Interior on contracts of	60	30
report of Secretary of Treasury on sinking fund for	44	25
Painter, Francis J., report of Secretary of Navy on retirement of	182	33
Parks, letter of Secretary of War relating to regulations for, in District of Columbia	144	31
Pascagoula River, Florida, report of engineers on survey of	83	30
Passenger act, letter of Secretary of Treasury relative to	72	30
Paul, Joseph, estimate of appropriation to pay	328	35
Pensacola, Fla., letter of Secretary of Treasury relative to additional lights at	45	25
Pension Board of Appeals, letter of Secretary of Interior relative to salaries of	154	31

Subject.	No.	Vol.
Pension Bureau, estimate for additional floor in building of	256	33
Pension Office, letter of Secretary of Interior relative to medical examiners in	164	31
Pension Office building, estimate of appropriation for completing	96	30
estimate of appropriation for completing	96	30
Pensions, estimates of additional appropriations for	162	31
additional estimates for appropriations for	162	31
Petroleum, report of Secretary of State on taxation by Holland of	254	33
Philadelphia, letter of Secretary of Treasury relative to additional watchmen at silver vaults in	169	31
Points, Abraham, message of President vetoing bill (H. R. 8556) to pension	373	35
Pork, report of Secretary of State relative to restrictions on American	181	33
Postal service, annual report of Postmaster-General on proposals for mail contracts	9	22
annual report of Postmaster-General on mail contracts	20	20
letter of Postmaster-General relative to pay of railway postal clerks	110	30
letter of Postmaster-General relative to application of eight-hour law to letter-carriers	71	30
Postmaster-General:		
Communications from—		
Mail contracts, annual report on proposals for	9	22
annual report on	20	20
Postal service, relative to pay of railway postal clerks	110	30
relative to application of eight hour law to letter-carriers	71	30
Postmasters, report on disallowed stationery accounts of	245	33
Post-Office Department, report of unsettled accounts in	97	30
Substitutes, relative to employment of	145	31
Trust funds, report on	330	35
Postmasters, report of Postmaster-General on disallowed stationery accounts of	245	33
Post-Office Department, report of Postmaster-General on unsettled accounts in	97	30
Potomac River, report of Secretary of War on fishways at Great Falls	272	33
Poughkeepsie, N. Y., estimate for approaches to public building at	42	25
Precious metals. (*See* Gold and Silver.)		
President of the United States:		
Annual message, with accompanying documents—		
Foreign Relations, part 1	1	1
Report of Secretary of War, 4 volumes, part 2	1	2–8
Report of Secretary of Navy, 2 volumes, part 3	1	9
Report of Postmaster-General, part 4	1	10
Report of Secretary of Interior, 5 volumes, part 5	1	11–15
Communications from—		
American vessels, transmitting report on seizure in British waters.	217 221	33 33
Bartholdi statue of Liberty, relative to inaugurating	232	33
Chinese immigration, relative to	102	30
Civil Service Commission, transmitting annual report of	140	31
Clarksburg, W. Va., relative to appropriation for public building at	366	35
Consular reports, transmitting	253	34
Crooks, James, transmitting report on claim of	161	31
Crow Indians, transmitting a report relative to	53	30
Cutting, A. K., relative to arrest in Mexico of	371	35
Foreign mercantile marine, transmitting report on	172	31
Holland, transmitting report on taxation of petroleum by	179	33
Indian Commissioner, transmitting annual report of	109	30
International copyright, transmitting diplomatic correspondence relative to	354	35
Kansas City, Fort Scott and Gulf Railroad, returning bill for	255	33
Mexican awards, transmitting report on claims of La Abra Mining Company and B. Weil under	274	33
Miami Indians, transmitting report relative to relief of	57	30

Subject.	No.	Vol.
President of the United States—Continued.		
Communications from—Continued.		
Milk-sugar, transmitting report on manufacture in Switzerland of..	188	33
Northern Cheyenne Indians, relative to condition of	17	20
Oleomargarine, relative to bill to tax manufacture of.....	368	35
Ounalaska (schooner), transmitting report on case of.....	329	35
Pacific railroads, transmitting report on contracts of.....	60	30
Petroleum, transmitting report on taxation by Holland of.....	254	33
Pork, transmitting report on foreign restrictions on importation of.	181	33
Round Valley Reservation, transmitting report on allotting lands of.	21	25
Santos, Julio R., transmitting report on imprisonment in Ecuador of	361	35
Shipping fees, relative to bill H. R. 4838, to abolish certain	277	33
South American Commission, transmitting report of.....	50	25
Substitutes, transmitting report on employment in Executive Departments of.....	160	31
Tonnage duties, transmitting diplomatic correspondence relative to.	132	31
Trust funds, transmitting report of Secretary of State on.....	362	35
Veto—		
Bill (H. R. 1471) to increase pension to Andrew J. Hill	226	33
Bill (H. R. 3019) to increase pension to Abigail Smith	227	33
Bill (H. R. 2145) for relief of Rebecca Eldridge.....	250	33
Bill (H. R. 1582) for relief of Eleanor C. Bangham.....	251	33
Bill (H. R. 1406) to pension S. W. Harden.....	252	33
Bill (H. R. 5997) to pension Elizabeth Luce.....	280	33
Bill (H. R. 1990) to pension John Hunter	282	35
Bill (H. R. 3624) to pension F. J. Leese	283	35
Bill (H. R. 6897) to pension Henry Hipple	284	35
Bill (H. R. 6136) to pension J. W. Farris	285	35
Bill (H. R. 4058) to pension J. D. Monroe	286	35
Bill (H. R. 3826) to pension John Taylor.....	287	35
Bill (H. R. 4002) to pension C. W. Tiller	288	35
Bill (H. R. 1007) to pension E. P. Hensley.....	289	35
Bill (H. R. 6718) to pension William H. Starr	298	35
Bill (H. R. 7108) to pension Andrew J. Wilson.....	299	35
Bill (H. R. 6372) to pension Charles A. Chase	300	35
Bill (H. R. 6774) to pension Bruno Schultz.....	301	35
Bill (H. R. 576) for relief of Louisa C. Beezeley	302	35
Bill (H. R. 7703) to pension Anna A. Probert	303	35
Bill (H. R. 6257) for relief of Julia Connelly	304	35
Bill (H. R. 424) to pension Giles C. Hawley.....	305	35
Bill (H. R. 7257) to pension James H. Darling.....	306	35
Bill (H. R. 7614) to increase pension to Hezekiah Tillman.....	307	35
Bill (H. R. 7109) to pension Joseph Tuttle.....	308	35
Bill (H. R. 1816) to pension Mary Ann Miller	309	35
Bill (H. R. 3205) to pension George W. Guyse	310	35
Bill (H. R. 6117) to pension James D. Cotton	311	35
Bill (H. R. 5995) to pension David T. Elderkin	312	35
Bill (H. R. 7222) to pension Sallie West	313	35
Bill (H. R. 7073) to pension Mary S. Woodson	314	35
Bill (H. R. 6895) to pension Sarah Harbaugh.....	315	35
Bill (H. R. 7401) to pension Samuel Miller	316	35
Bill (H. R. 7931) to increase pension of Clark Boon.....	317	35
Bill (H. R. 7162) to pension Martha McIlwain.....	318	35
Bill (H. R. 7298) for the relief of Charles Schuler	319	35
Bill (H. R. 6688) for relief of William Bishop	320	35
Bill (H. R. 7979) to pension Jackson Stewart	321	35
Bill (H. R. 7436) to pension Mary Anderson.....	322	35
Bill (H. R. 6752) to pension Alice E. Travers	323	35
Bill (H. R. 6266) to pension Philip Arner	324	35
Bill (H. R. 6192) to pension Mary Norman	325	35
Bill (H. R. 6170) to pension Mary A. Van Etten.....	326	35
Bill (H. R. 7167) for relief of Maria Hunter	327	35
Bill (H. R. 472) to pension William Boone	332	35
Bill (H. R. 7018) to pension Aretus F. Loomis.....	333	35
Bill (H. R. 1818) to pension H. L. Kyler	334	35

Subjects.	No.	Vol.
President of the United States—Continued.		
Communications from—Continued.		
Veto—Continued.		
Bill (H. R. 5603) to pension Catharine McCarty	335	35
Bill (H. R. 6648) to pension Edward M. Harrington	336	35
Bill (H. R. 5394) to pension Sally A. Bradley	337	35
Bill (H. R. 3640) to pension James T. Irwin	338	35
Bill (H. R. 4426) to pension Fannie E. Evans	339	35
Bill (H. R. 5550) to erect public building at Duluth, Minn	340	35
Bill (H. R. 2043) to pension Mary Karstetter	341	35
Bill (H. R. 5306) to pension Roxana V. Rowley	342	35
Bill (H. R. 4797) to pension Robert H. Stapleton	343	35
Bill (H. R. 5021) to pension Margaret A. Jacoby	344	35
Bill (H. R. 5414) to pension Maria Cunningham	345	35
Bill (H. R. 3304) to pension Abner Moorehead	346	35
Bill (H. R. 4782) to pension Elizabeth McKay	347	35
Bill (H. R. 3043) to pension Lewis W. Scanland	348	35
Bill (H. R. 3613) to pension William H. Nevil	349	35
Bill (H. R. 2971) to pension Francis Deming	350	35
Bill (H. R. 4642) to pension James Carroll	351	35
Bill (H. R. 1059) to pension Jacob Romiser	352	35
Bill (H. R. 1505) to pension William Dermody	353	35
Bill (H. R. 524) to pension D. H. Ross	355	35
Bill (H. R. 5546) to erect public building at Asheville, N. C	357	35
Bill (H. R. 1391) to erect public building at Springfield, Mo	364	35
Bill (H. R. 3363) to pension Jennette Dow	367	35
Bill (H. R. 9106) to pension Rachel Barnes	369	35
Bill (H. R. 8336) to increase pension of Duncan Forbes	370	35
Bill (H. R. 8556) to pension Abraham Points	373	35
Bill (H. R. 7234) to pension Susan Hawes	374	35
Bill (H. R. 5389) to pension Ann Kinney	375	35
Bill (H. R. 3551) to pension G. W. Cutler	376	35
Bill (H. R. 1584) for the relief of A. C. Richardson	377	35
Private land claims:		
Florida: Report of Secretary of Interior on Hanson grant	331	35
New Mexico, estimate of appropriations for survey of	146	31
Report of Secretary of Interior on San Tomas de Yturbide claim	196	33
Letter of Secretary of Interior relative to adjustment of	209	33
Probert, Anna A., message of President vetoing bill (H. R. 7703) to pension	303	35
Produce Exchange, New York City, report of Secretary of War on purchase of	13	20
Public buidings, estimate of appropriations for repairs of	113	30
for heating apparatus in certain	128, 358	31, 35
for repair of	214, 217, 218	33, 33, 33
Public documents, annual report on distribution of	[illegible]	30
Public lands, suspended entries, annual list of	30	25
Public printing, estimate of deficiency appropriation for	222	33
Q.		
Quartermaster's Department, estimates of appropriations for	93	30
R.		
Receipts and expenditures, annual report of, 1882	31	27
1885	29	27
1883	365	35
Receipts and expenditures and public debt, report on, to 1885	116	21
Records. (*See* Hall of Records.)		
Register's Office. (*See* Treasury Department.)		
Richardson, A. C., message of President vetoing bill (H. R. 1584) for relief of	377	35

Subjects.	No.	Vol.
Rivers and harbors, letter of Secretary of War relative to appropriations	372	35
Rochester, N. Y., letter of Secretary of Treasury relative to appropriation for public building at	236	33
Romiser, Joseph, message of President vetoing bill (H. R. 1059) to pension	352	35
Ross, D. M., message of President vetoing bill (H. R. 524) to pension	355	35
Round Valley Reservation. (*See* Indians.)		
Rowley, Roxana V., message of President vetoing bill (H. R. 5306) to pension	342	35
S.		
Saco River, Me., report of engineers on survey of	37	25
Saint Mary's Falls Canal, letter of Secretary of War relative to improving	61	30
Santa Fé, N. Mex., letter of Secretary of Interior relative to repairing adobe palace at	105	30
Santee River, S. C., report of engineers on improvement at	114	30
Santos, Julio R., report of Secretary of State of imprisonment in Ecuador of	361	35
Saugatuck River, report of engineers on survey of	76	30
Scanland, Lewis W., message of President vetoing bill (H. R. 3043) to pension	348	35
Schuler, Charles, message of President vetoing bill (H. R. 7298) for relief of	319	35
Schultz, Bruno, message of President vetoing bill (H. R. 6774) to pension	301	35
Seamen, estimate of appropriation for shipping and discharging seamen at Liverpool	193	33
Secretary of Interior:		
Communications from—		
Denver and New Orleans Railroad, relative to discriminations against	186	33
Hanson, John H., relative to land survey of	331	35
Indian depredation claims, report on	125	31
Interior Department, annual report on contingent expenditures of	15	20
Joseph, Richard, relative to accounts of	127	31
Medical examiners in Pension Office, relative to	164	31
Mescalero Reservation, relative to paying settlers for impovements	221	33
Miami Indians, relative to relief of	57	30
relative to funds of	23	25
Northern Cheyenne Indians, relative to condition of	17	20
Oregon wagon-road grants, relative to	131	30
Pacific Railroads, relative to contracts of	60	30
Pension board of appeals, relative to salaries of	154	31
Private land claims, report on Santa Tomas de Yturbide claim, New Mexico	196	33
Public documents, annual report on distribution of	78	30
Round Valley Reservation, on allotting lands of	21	25
Santa Fé, N. Mex., relative to repairing adobe palace at	105	30
Suspended entries of public lands, annual report on	30	25
Trust funds, statement of	168	31
Secretary of Navy:		
Communications from—		
Navy Department, annual report of contingent expenditures of	47	25
on employés in	65	30
relative to employment of substitutes in	156	31
Norfolk navy-yard, relative to	118	30
Painter, F. J., relative to retirement of	182	33
Retired officers, list of	111	30
Trust funds, report on	263	33
Vessels, relative to progress on steel cruisers	185	33
Washington navy-yard, relative to ordnance shops in	139	31

Subjects.	No.	Vol.
Secretary of State:		
Communications from—		
Bordeaux International Congress, relative to	205	33
Compagnie Générale Transatlantique, relative to claim of	206	33
Consular reports, transmitting	253	33
Crooks, James, relative to claim of	161	31
Cutting, A. K., relative to arrest in Mexico of	371	35
Department of State, annual report on expenditures of	12	20
Foreign mercantile marine, report on	172	31
French spoliation claims, report of Mr. Tuck on	194	33
Holland, on taxation of petroleum by	179	33
	254	33
International copyright, diplomatic correspondence relative to	354	35
Mexican awards, relative to claims of La Abra Mining Company and B. Weil under	274	33
Milk sugar, on manufacture in Switzerland of	188	33
Onnalaska (schooner), relative to case of	329	35
Petroleum, relative to taxation by Holland of	254	33
Pork, on foreign restrictions on importation of	181	33
Santos, Julio R., relative to imprisonment in Ecuador of	361	35
Sitting Bull, relative to claim of J. L. Lagaré in procuring surrender of	356	35
State Department, annual report on clerks in	52	30
Substitutes, relative to employment in Executive Departments of	160	31
Tonnage duties, diplomatic correspondence relative to	132	31
Trust funds: report on	362	35
Secretary of Treasury:		
Communications from—		
Annual report	2	18
Alaska, relative to accounts of secretary of	276	33
Andrews, C. C.: relative to reimbursement of	124	31
Appropriations, supplemental estimates for	176	33
estimates for building at Fort Leavenworth, and purchase of land at Jeffersonville and Neptune Island	178	33
estimates for ensuing fiscal year	5	21
Attorneys-General, relative to vouchers for cost of portraits of	229	33
Balances, report of balances due to and from United States	363	35
Bartholdi statue of Liberty, estimate of appropriation for inaugurating	249	33
Beard, W. H., estimate to pay claim of	241	33
Boise City penitentiary, relative to enlarging	54	30
Bonaveris, Paul, estimate of appropriation to pay	198	33
Boston sub-treasury, relative to payment of silver dollars at	163	31
Brooklyn, N. Y., relative to increasing cost of public building at	129	31
Bureau of Engraving and Printing, relative to improving building at	170	31
Bureau of Labor, estimates of appropriation for	69	30
Cadwallader, J. F., relative to amount of	67	30
Cape Orford light, estimate of appropriation for	138	31
Capitol grounds, relative to appropriation for improving	104	30
Carson City mint, relative to appropriation for	267	33
Census, estimate of appropriation for	191	33
Census of Indians, estimate of appropriations for taking	79	30
Central Pacific Railroad, estimates of appropriation to pay transportation claims of 1865	270	33
Central Pacific Railroad, estimates to pay mail service	280	33
Chargés d'affaires, estimate of deficiency appropriation for salaries of	261	33
Claims, list of claims allowed for which no appropriations made	210	33
list of claims allowed under exhausted appropriations	225	33
estimate of appropriation for defending suits against United States for	211	33
list of, allowed	294	35
list of claims allowed by Court of Claims	233	33
allowed	70	30

Subjects.	No.	Vol.
Secretary of Treasury—Continued.		
Communications from—		
Coal, relative to drawbacks on	201	33
Coast survey, annual report of expenditures	32	25
annual report	18	23
Collectors of customs, relative to suits against	148	31
Commissioners, additional estimates of appropriations for	204	33
Consuls, estimate of appropriations for salaries of alien	239	33
Corwin, report of cruise	153	32
Court of Claims, estimate of appropriations for judgments of	275	33
Cree Indians, estimate for relief of	231	33
Crow Indians, relative to appropriation for allotment of lands to	53	30
Customs cases, annual report of awards to informers in	14	20
relative to revision of laws regulating	43	25
districts, relative to non-paying	238	33
officers, annual report on emoluments of	56	30
Department of Justice, estimate for fitting up building for	189	33
Deputy Comptroller of Currency, relative to salary of	103	30
Direct tax of 1861, relative to	158	31
District of Columbia, estimate of appropriation for education of feeble-minded children in	80	30
estimates of appropriations for schools in	84	30
estimate of appropriation for public-school buildings	223	33
Fort Douglas, estimate to enlarge	112	31
Fort Hamilton, estimate of appropriation for purchase of ground at	216	33
Fort Niagara, estimate of appropriation for protecting site of	292	35
Fortifications, relative to appropriation for armament of	259	33
Freedmen's Hospital, estimate of appropriation for repairs at	88	30
French spoliation claims, estimate of appropriation for securing evidence in	266	33
Galveston, Tex., relative to act for erection of public building at	85	30
Gondolfo, Cæsar, on claim of	74	30
Governor's Island, New York, relative to beacon-light on	159	31
Grand Island, Mississippi, estimate for erecting light-house at	137	31
Gray's Harbor, relative to additional appropriations for light-house at	98	30
relative to appropriation for light-house at	65	30
Hall of records, recommending erection of	143	31
Hannibal, Mo., relative to increasing cost of public building at	150	31
Hendricks, T. A., estimate of appropriation for engraved portraits of	151	31
Hot Springs, Ark., estimates of appropriations for improvement at	212	33
Humboldt Bay, California, relative to removing light-house at	91	30
Immigration, relative to regulation of	141	31
Import duties, annual report on refunds of	16	20
Indian Office, estimate of appropriation for clerical force in	89	30
Interior Department, estimate for reconstructing east wing of building	230	33
Internal-revenue collectors, relative to commissions to	1910	.....
laws, relative to amending section 12 of act of 1879	149	31
Jurors' fees, additional estimates of appropriations for	173	33
Lancaster, R. D., relative to charges against	360	35
Lehman, L., relative to reappraisement of glassware imported by	22	25
Light-house depot for fourteenth district, relative to an appropriation for	40	25
Light-houses, estimates of appropriations for repair of	269	33
Mackinac Indian agency, estimate for compensation of agent at	234	33
Mare Island navy-yard, estimate of appropriations for quarters and barracks at	279	33
Marine Corps, additional estimates of appropriations for	202	33
Marine Hospital Service, relative to an additional surgeon-general in	187	33
Minor coin, estimate for transportation of	247	33

Subjects.	No.	Vol.
Secretary of Treasury—Continued.		
Communications from—		
Mint, relative to salaries of officers of	126	31
relative to appropriation for	87	30
estimate of appropriation for boilers at Philadelphia	273	33
Montana, estimate of appropriation for legislative expenses of	123	31
National Museum, estimate of appropriations for	291	35
Navajo Reservation, estimate of appropriation for artesian wells on	263	33
Navy, estimate of appropriation for armament of new cruisers	215	33
Navy Department, estimate to pay carpenters at	242	33
estimate for pay of draftsmen in Bureau of Steam Engineering in	243	33
estimate of deficiency appropriation for Bureau of Ordnance	195	33
New Orleans, La., report on moneys seized by military authorities at	101	30
New York, estimate of appropriation for an assistant collector at	240	33
appraiser's store, on additional accommodations for	94	30
New York barge office, estimate of appropriation for repairing	220	33
New York post-office, letter of Secretary of Treasury relative to sale of old site	235	33
New York subtreasury, estimates of appropriations for	180	33
Nickel and copper coins, relative to reissue of	174	33
Pacific railroads, on sinking fund for	44	25
Passenger act, relative to	72	30
Paul, Joseph, estimate of appropriation to pay	328	35
Pension building, estimate for an additional floor in	256	33
Philadelphia, Pa., relative to additional watchmen at silver vaults in	169	31
Poughkeepsie, N. Y., estimate for approaches to public building at	42	25
Precious metals, annual report on production of	290	36
Private land claims, estimate of appropriation for surveys in New Mexico of	146	31
Public buildings, estimate of appropriation for heating apparatus	128	31
in certain	358	35
estimate of appropriations for repair of	113	30
estimates of appropriations for repairs of certain	214	33
	217	33
	218	33
Public printing, estimate of deficiency appropriation for	222	33
Quartermaster's Department, estimates of appropriations for	93	30
Receipts and expenditures, annual report for 1882	31	27
annual report for 1885	29	27
annual report for 1883	365	35
Receipts and expenditures and public debt, report on	116	21
Register's Office, estimates of appropriations for	95	30
relative to salaries in	99	30
Rochester, N. Y., relative to appropriation for public building at	236	33
Round Valley Indian Agency, estimate of appropriations for	295	35
Seamen, estimate of appropriation for shipping and discharging seamen at Liverpool	193	33
Securities, relative to destruction of mutilated	167	31
Shearman, G. K., relative to claim of	262	33
Signal Service, estimate of additional appropriations for	120	31
Silver balances, relative to statement of	64	30
Silver dollars, estimate of appropriation for storage and transportation of	142	31
relative to circulation of	100	30
Sinking fund, amount applied to	66	30
Sioux Indians, estimate to pay claims of Red Cloud and Read Leaf bands of	35	25
State Department, estimate of appropriation for printing and binding for	86	30
Statistical abstract, annual report of	26	25
Steam-boilers, relative to laws governing construction of	55	30

Subjects.	No.	Vol.
Secretary of Treasury—Continued.		
Communications from—		
Steam-vessels, relative to appointment of watchmen on	63	30
relative to amending laws for inspection of	359	35
Stills, relative to paying drawbacks on exports of	46	25
Substitutes, on employment	166	31
Surveyor-general of Arizona, relative to salary of	106	30
Tariff, relative to revision of	147	31
Tariff act of 1883, questions arising under	68	30
Testing-machine, estimate of appropriation for	73	30
Thomas, Thomas, relative to refunding fine to	258	33
Tokio, Japan, estimate of appropriation to pay rental of legation buildings at	213	33
Treasury building, estimate of appropriation to improve sanitary condition of	219	33
Treasury Department, annual report on contingent expenditures of	10	20
estimate of deficiency appropriation for custodians and janitors in	199	33
estimate of appropriations for printing for	95	30
relative to applying unexpended appropriations to deficiencies in	237	33
recommending additional clerk in disbursing office of	260	33
Trust funds, report on	293	35
Two Harbors, Minn., estimate for light station at	203	33
Utah, estimate for furniture for office of governor of	257	33
War claims, list of those allowed under act of July 4, 1865	34	25
Wichita, Kans., relative to appropriation for public building at	208	33
Witness and juror fees, estimate of deficiency appropriation for	244	33
Wyoming penitentiary, relative to enlarging	157	31
Secretary of War:		
Communications from—		
Army, annual report on expenditure of contingent fund of	77	30
Army and Navy hospital at Hot Springs, relative to	296	35
Army transportation, relative to appropriation for	192	33
Artillery school, relative to erecting building for	171	31
relative to pay of enlisted men employed at	108	30
Artillery light batteries, relative to organization of	115	30
Balances, report of balances on books of War Department	133	31
Block Island, relative to submarine cable at	197	33
Boston Harbor, relative to repairing sea-wall in	136	31
District of Columbia water supply, relative to appropriation for	39	25
Fort Brady, relative to sale of	81	30
Fort Leavenworth, relative to encroachment of river at	121	31
Fort Monroe, plans and estimates for permanent wharf at	28	25
Fort Porter, estimate for rebuilding	130	31
Great Falls, on fishways at	272	33
Green and Barren River Navigation Company, relative to purchasing franchises of	152	31
Hennepin Canal, surveys of routes for	117	30
Leavenworth military prison, relative to application of appropriation for	200	33
Mileage, relative to	134	31
Military Academy, estimate of appropriations for	119	31
Military Academy, relative to appropriations for	135	31
Mississippi River Commission, supplemental report of	38	25
Missouri River Commission, report of	41	25
Olcott Harbor, New York, estimate for repairs at	228	33
Produce Exchange building, New York, relative to purchase of, for Army use	13	20
Public parks in District of Columbia, relative to regulations for	144	31
Rivers and harbors, report on survey of Saco River, Maine	37	25
report on survey of Muskingum River	48	25
relative to appropriations for	372	35

Subjects.	No.	Vol.
Secretary of War—Continued.		
Communications from—		
Rivers and harbors, survey of Saugatuck	76	30
survey of Arkansas River	90	30
survey of Waccissa River, Florida	82	30
survey of Pascagoula River, Florida	83	30
improvement of Galveston Harbor	85	30
improvement of Santee River, South Carolina	114	30
Saint Mary's Fall Canal, relative to improving	61	30
Signal Service, memorial of enlisted men relative to commutations	297	35
relative to appropriations for	248	33
relative to estimates of appropriations for	92; 175	30; 33
Signal Service, map, relative to claim of American Graphic Company for publishing	183	33
South Pass, Mississippi River, relative to appropriations for continuing examinations of	75	30
relative to regulations for using	58	30
Substitutes, on employment of	165	31
Trust funds, report on	278	33
War Department, annual report on contingent expenditures of	8	20
War Department library, relative to binding for	268	33
Willets Point, N. Y., plans and estimates for buildings at	25	25
Securities, letter of Secretary of Treasury relative to destruction of mutilated	167	31
Shearman, George K., report of Secretary of Treasury on claim of	262	33
Shipping fees, message of President relative to House bill 4838 to abolish certain	277	33
Signal Service, estimate of additional appropriations for	120	31
letter of Secretary of War relative to estimates of appropriations for	92; 175	30; 33
letter of Secretary of War relative to appropriations for	248	33
memorial of enlisted men relative to commutation for fuel and quarters	297	35
report of Secretary of War on claim of American Graphic Company against	183	33
Silver. (*See* Coins and Coinage.)		
Sinking Fund. (*See* Debt of United States.)		
Sioux Indians. (*See* Indians.)		
Sitting Bull (*Indian*), letter of Secretary of State relative to claim of J. L. Legaré in securing surrender of	356	35
Smith, Abigail, message of President vetoing bill (H. R. 3019) increasing pension of	227	33
South American Commission, report of	50	25
South Pass. (*See* Mississippi River.)		
Springfield, Mo., message of President vetoing bill (H. R. 1391) to erect public building at	364	35
Stapleton, Robert H., message of President vetoing bill (H. R. 4797) to pension	343	35
Starr, William H., message of President vetoing bill (H. R. 6718) to pension	298	35
State Department. (*See* Department of State)		
Statistical abstract, annual report of	26	25
Steam vessels, letter of Secretary of Treasury relative to appointment of watchmen on	63	30
letter of Secretary of Treasury to amending laws for inspection of	359	35
letter of Secretary of Treasury relative to laws governing construction of boilers for	55	30
Steward, Jackson, message of President vetoing bill (H. R. 7979) to pension	321	35
Stills, letter of Secretary of Treasury relative to drawbacks on exports of	46	25
Switzerland, report of Secretary of State on manufacture of milk-sugar in	188	33
Symons, Thomas, letter of Attorney-General relative to claim of	177	33

Subjects.	No.	Vol.
T.		
Tariff. (*See* Import duties.)		
Taylor, John, message of President vetoing bill (H. R. 3826) to pension	287	35
Testing machine. (*See* Iron and steel tests.)		
Thomas, Thomas, letter of Secretary of Treasury relative to refunding fine to	258	33
Tiller, C. W., message of President vetoing bill (H. R. 4002) to pension	288	35
Tillman, Hezekiah, message of President vetoing bill (H. R. 7614) to increase pension of	307	35
Tobacco, report of Secretary of State on taxation by Holland of exports of	179	33
Tokio, Japan, estimate of appropriation for rental of legation buildings at	213	33
Tonnage duties, report of Secretary of State on claims of foreign Governments relative to	132	31
Travers, Alice E., message of President vetoing bill (H. R. 6752) to pension	323	35
Treasury Department, annual report on contingent expenditures of	10	20
estimate of deficiency appropriations for custodians and janitors in	199	33
estimate of appropriation for improving sanitary condition of	219	33
estimate of appropriations for printing for	95	30
letter of Secretary relative to salaries in Register's office	99	30
letter of Secretary relative to applying unexpended appropriations to deficiencies	237	33
letter of Secretary relative to salary of Deputy Comptroller of Currency	103	30
letter of Secretary recommending additional clerk in disbursing office of	260	33
Trust funds, report of Secretary of Navy on	264	33
Attorney-General on	271	33
Secretary of War on	278	33
Postmaster-General on	330	35
Secretary of Interior on	168	31
Secretary of State on	362	35
Secretary of Treasury on	293	35
Tuttle, Joseph, message of President vetoing bill (H. R. 7109) to pension	308	35
Two Harbors, Minnesota, estimate for light station at	203	33
U.		
Utah, estimate for furniture for office of governor of	257	33
V.		
Van Etten, Mary A., message of President vetoing bill (H. R. 6170) to pension	326	35
W.		
Waeissa River, Florida, report of engineers on survey of	82	30
Wagon roads. (*See* Oregon.)		
War Department, annual report on contingent expenditures	8	20
letter of Secretary of War relative to binding for library of	268	33
report of balances due to and from United States on books of	133	30
Washington navy-yard, report of Secretary of Navy on ordnance shops in	139	30
Weil, Benjamin, report of Secretary of State on claim of	284	35
West, Sallie, message of President vetoing bill (H. R. 7222) to pension	313	35

Subjects.	No.	Vol.
Wichita, Kans., letter of Secretary of Treasury relative to appropriation for building at	208	33
Willets Point, New York, plans and estimates for buildings at	25	25
Wilson, Andrew J., message of President vetoing bill (H. R. 7108) to pension	299	35
Witnesses. (*See* Courts of United States.)		
Woodson, Mary S., message of President vetoing bill (H. R. 7073) to pension	314	35
Wyoming, letter of Secretary of Treasury relative to enlargement of penitentiary in	157	31

49TH CONGRESS, 1st Session. } HOUSE OF REPRESENTATIVES. { Ex. DOC. 1, Part 2.

REPORT

OF THE

SECRETARY OF WAR;

BEING PART OF

THE MESSAGE AND DOCUMENTS

COMMUNICATED TO THE

TWO HOUSES OF CONGRESS

AT THE

BEGINNING OF THE FIRST SESSION OF THE FORTY-NINTH CONGRESS.

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APPENDIXES

TO THE

REPORT OF THE CHIEF OF ENGINEERS,

UNITED STATES ARMY.

(CONTINUED.)

CONTENTS.

[Alphabetical Index will be found at the end of each Part.]

PART I.

OFFICERS OF THE CORPS OF ENGINEERS 3

SEA-COAST AND LAKE FRONTIER DEFENSES.

General discussion 4

ESTIMATES OF APPROPRIATIONS FOR 1886–7 5

NORTHERN FRONTIER.—Ft. Wayne, Mich., 5; Ft. Porter, N.Y., 5; Ft. Niagara, N. Y., Ft. Ontario, N. Y., 6; Ft. Montgomery, N. Y., 7. THE PENOBSCOT, ME.—Ft. Knox, 7. THE KENNEBEC, ME.—Ft. Popham, 7. PORTLAND, ME.—Ft. Gorges, Ft. Preble, Ft. Scammel, 8; battery on Portland Head, batteries on Cow Id., batteries on Great Hog Id., 9. PORTSMOUTH, N. H., AND NAVY-YARD AT KITTERY, ME.—Ft. McClary, Ft. Constitution, battery on Gerrish's Id., battery on Jerry's Point, 10. BOSTON AND NAVY-YARD AT CHARLESTOWN, MASS.—Ft. Warren, battery at Long Id. Head, 11; Ft. Winthrop, Ft. Independence, 12. NEW BEDFORD, MASS.—Fort at Clark's Point, 12. NARRAGANSETT BAY, R. I —Ft. Adams, 13; defenses of Dutch Id., 14; Ft. Greene, 15. NEW LONDON HARBOR AND NAVY-YARD, CONN.—Ft. Trumbull, 15; Ft. Griswold, 16. NEW HAVEN, CONN.—Ft, Hale, 16. NEW YORK AND NAVY-YARD AT BROOKLYN.—Ft. Schuyler, fort at Willets Point, 16; defenses of Governor's Id., sea-wall on Governor's Id., 17; Ft. Wood, Ft. Hamilton and additional batteries, 18; mortar battery, Ft. Hamilton, Ft. Lafayette, Ft. Wadsworth, 19; fort on site of Ft. Tompkins, 20; Glacis Gun Battery (n. of fort on site of Ft. Tompkins), Glacis Mortar Battery (s. of fort on site of Ft. Tompkins), Battery Hudson, 21; South Mortar Battery, North Cliff Battery, 22; South Cliff Battery, Two-gun Battery near fort on site of Ft. Tompkins, 23; fort at Sandy Hook, 24. PHILADELPHIA AND LEAGUE ISLAND NAVY-YARD.—Ft. Mifflin, 25; mortar battery at Ft. Mifflin, site for defenses at Red Bank, Ft. Delaware, 26; battery at Finn's Point, mortar battery at Finn's Point, 27; fort opposite Ft. Delaware, mortar battery opposite Ft. Delaware, 28. BALTIMORE, MD.—Ft. McHenry, 28; Ft. Carroll, 29. WASHINGTON, D. C.—Ft. Foote, 29; Ft. Washington, 30; obstructions of the Potomac, 31. HAMPTON ROADS AND GOSPORT NAVY-YARD, VA.—Ft. Monroe, 31; artesian well at Ft. Monroe, Ft. Wool, 32. BEAUFORT HARBOR, N. C.—Ft. Macon, 33. WILMINGTON, N. C.—Ft. Caswell, 34. CHARLESTON, S. C.—Ft. Moultrie, 34; Ft. Sumter, Ft. Johnson, 35; Castle Pinckney, 36. SAVANNAH, GA.—Ft. Oglethorpe, Ft. Pulaski, 36; new fort on Tybee Id., 37. CUMBERLAND SOUND.—Ft. Clinch, 37. SAINT AUGUSTINE, FLA.—Ft. Marion, 38. KEY WEST, FLA.—Ft. Taylor and batteries, 38. HARBOR OF DRY TORTUGAS, FLA.—Ft. Jefferson, 39. PENSACOLA HARBOR AND NAVY-YARD, FLA.—Ft. Pickens, 39; Ft. Barrancas and redoubt, Ft. McRee, 40. MOBILE, ALA.—Ft. Morgan, Ft. Gaines, 41. MISSISSIPPI SOUND.—Fort on Ship Island, 41. NEW ORLEANS, LA.—Ft. Pike, Ft. Macomb, 42; Tower Dupré, Battery Bienvenue, tower at Proctorsville, Ft. Jackson, 43; Ft. St. Philip, Ft. Livingston, 44. GALVESTON, TEX.—Batteries at the entrance to the harbor of Galveston, 45. SAN DIEGO HARBOR, CALIFORNIA.—Fort at San Diego, 45. SAN FRANCISCO, NAVY-YARD AT MARE ISLAND AND ARSENAL AT BENICIA, CAL.—Ft. Winfield Scott, 45; fort at Lime Point, 46; fort on Alcatraz Id., Ft. Mason, batteries on Angel Id., 47.—DEFENSES OF THE COLUMBIA, OREG., AND WASH.—Ft. Stevens, Ft. Canby, 48.

THE BOARD OF ENGINEERS.

Officers constituting Board, Fortifications, 48; *Rivers and harbors*, 49; *Coast defenses, Torpedo defense*, 50; *Estimate for service of torpedoes*, 51.

BOARD OF ENGINEERS FOR THE PACIFIC COAST.

Officers constituting the Board 52
BATTALION OF ENGINEERS AND ENGINEER SCHOOL OF APPLICATION 52
ENGINEER POST AND DEPOT OF WILLETS POINT, NEW YORK HARBOR 53

RIVER AND HARBOR IMPROVEMENTS.

GENERAL STATEMENT 53

ATLANTIC COAST AND GULF OF MEXICO.

IN CHARGE OF COL. C. E. BLUNT, CORPS OF ENGINEERS—

Lubec Channel, Me., Bangor Harbor and Penobscot River, Me., 55; Moose-a-bec Bar at Jonesport, Me., 56; Belfast Harbor, Me., Rockland Harbor, Me., 57; Portland Harbor, Me., Kennebunk River, Me., breakwater at mouth of Saco River, Me., Portsmouth Harbor, N. H., 58; Cocheco River, N. H., 59; examinations and surveys, 60.

IN CHARGE OF MAJ. CHARLES W. RAYMOND, CORPS OF ENGINEERS—

Newburyport Harbor, Mass., 60; Merrimac River, Mass., 61; Scituate Harbor, Mass., 62; Boston Harbor, Mass., 63; Plymouth Harbor, Mass., Provincetown Harbor, Mass., 64; Lynn Harbor, Mass., 65; Malden River, Mass., harbor of refuge at Sandy Bay, Cape Ann, Mass., 66; examinations and surveys, 67.

IN CHARGE OF LIEUT. COL. GEORGE H. ELLIOT, CORPS OF ENGINEERS—

Harbor of refuge at Hyannis, Mass., harbor of refuge at Nantucket, Mass., 68; Wood's Holl and harbor of refuge at Wood's Holl, Mass., 69; Wareham Harbor, Mass., 70; Taunton River, Mass., 71; Pawtucket River, R. I., Providence River and Narragansett Bay, R. I., 73; Newport Harbor, R. I., 75; harbor of refuge at Block Island, R. I., 76; Little Narragansett Bay, R. I., Conn., harbor of refuge at Stonington, Conn., 78; examinations and surveys, 79.

IN CHARGE OF LIEUT. COL. WALTER MCFARLAND, CORPS OF ENGINEERS—

Connecticut River, Mass. and Conn., 80; Thames River, Conn., 81; New London Harbor, Conn., 82; Clinton Harbor, Conn., New Haven Harbor, Conn., 83; breakwater at New Haven Harbor, Conn., Milford Harbor, Conn., 84; Housatonic River, Conn., Bridgeport Harbor, Conn., 85; Black Rock Harbor, Conn., Southport Harbor, Conn., 86; Norwalk Harbor, Conn., Port Chester Harbor, N. Y., 87; New Rochelle Harbor, N. Y., 88; Echo Harbor, New Rochelle, N. Y., Mamaroneck Harbor, N. Y., Greenport Harbor, N. Y., 89; Port Jefferson Harbor, N. Y., Flushing Bay, N. Y., 90; Newtown Creek, N. Y., 91; Buttermilk Channel, N. Y., 92; Gowanus Bay, N. Y., Harlem River, N. Y., 93; Hudson River, N. Y., harbor at Rondout, N. Y., 94; harbor at Saugerties, N. Y., removing sunken vessels or craft obstructing or endangering navigation, 95; examinations and surveys, 95.

IN CHARGE OF BRIG. GEN. JOHN NEWTON, CHIEF OF ENGINEERS, BVT. MAJ. GEN., U. S. A.—

Removing obstructions in East River and Hell Gate, N. Y., 96.

IN CHARGE OF MAJ. GEORGE L. GILLESPIE, CORPS OF ENGINEERS, BVT. LIEUT. COL., U. S. A.—

East Chester Creek, N. Y., Canarsie Bay, N. Y., 98; Sheepshead Bay, N. Y., 99; Sumpawanus Inlet, N. Y., 100; Cheesequakes Creek, N. J., 101; Passaic River above Newark, N. J., 102; Passaic River below Newark, and removing shoals in Newark Bay, N. J., 103; channel between Staten Island and New Jersey, 104; Shrewsbury River, N. J., 105; Rahway River, N. J., Elizabeth River, N. J., 106; Woodbridge Creek, N. J., Manasquan River, N. J., 107; Raritan Bay, N. J., 108; Raritan River, N. J., 109; Mattawan Creek, N. J., Keyport Harbor, N. J., 111; South River, N. J., 112; Gedney's Channel, New York Harbor, 113; Removing sunken vessels or craft obstructing or endangering navigation, 114; examinations and surveys, 114.

In charge of Lieut. Col. Henry M. Robert, Corps of Engineers—

Delaware River from Trenton, N. J., to its mouth, 115; Delaware River between Trenton, N. J., and Bridesburg, Pa., 116; Delaware River below Bridesburg, Pa., 117; Delaware River at Schooner Ledge, 118; Delaware River near Cherry Island Flats, Frankford Creek, Pa., Schuylkill River, Pa., 119; ice harbor at Marcus Hook, Pa., 120; ice harbor at the head of Delaware Bay, Del., construction of iron pier in Delaware Bay near Lewes, Del., 121; Delaware Breakwater harbor, Del., 122; Rancocas River, N. J., Woodbury Creek, N. J., Mantua Creek, N. J., 123; Raccoon River, N. J., Salem River, N. J., 124; Cohansey Creek, N. J., North Branch of Susquehanna River, Pa., 125; removal of wrecks from Delaware Bay and River, removing sunken vessels or craft obstructing or endangering navigation, United States commission advisory to the Board of Harbor Commissioners of Philadelphia, Pa., 126; examinations, 126.

In charge of Mr. William F. Smith, U. S. Agent—

Maurice River, N. J., Wilmington Harbor, Del., 127; ice harbor at New Castle, Del., 128; Duck Creek, Del., Saint Jones River, Del., 129; Mispillion Creek, Del., Broadkiln River, Del., Broad Creek, Del., from its mouth to Laurel, 130; Indian River, Del., Susquehanna River above and below Havre de Grace, Md., 131; Elk River, Md., 132; Chester River at Kent Island Narrows, Md., Chester River from Spry's Landing to Crumpton, Md., Corsica Creek, Md., 133; harbor at Annapolis, Md., Choptank River, Md., 134; harbor of Cambridge, Md., 135; Wicomico River, Md., Upper Thoroughfare, between Deil's Island and the mainland, Md., 136; removing sunken vessels or craft obstructing or endangering navigation, 137; examinations and surveys, 137.

In charge of Lieut. Col. William P. Craighill, Corps of Engineers—

Patapsco River and channel leading to Baltimore, Md., 137.

In charge of Maj. Peter C. Hains, Corps of Engineers, Byt. Lieut. Col., U. S. A.—

Harbors at Washington and Georgetown, D. C., 139; Potomac River at Washington, D. C., 140; James River, Va., 142; Shenandoah River, W. Va., 143.

In charge of Mr. S. T. Abert, U. S. Agent—

Channel at Mount Vernon, Va., Neabsco Creek, Va., 144; Breton Bay, Leonardtown, Md., Nomini Creek, Va., 145; harbor at entrance of Saint Jerome's Creek, Md., Rappahannock River, Va., 146; Totusky River, Va., 147; Urbana Creek, Va., Mattaponi River, Va., Pamunky River, Va., 148; York River, Va., 149; Chickahominy River, Va., Staunton River, Va., 150, 151; Dan River, between Madison, N. C., and Danville, Va., 151; Roanoke River, N. C., French Broad River, N. C., 152; examinations and surveys, 153.

In charge of Capt. F. A. Hinman, Corps of Engineers—

Harbor at Norfolk, Va., 153; approach to Norfolk Harbor and the U. S. (Norfolk) navy-yard, between Lambert's Point and Ft. Norfolk, Va., 154; Appomattox River, Va., 155; Nottoway River, Va., 156; Blackwater River, Va., Archer's Hope River, Va., 157; North Landing River, Va. and N. C., 158; Edenton Bay, N. C., Currituck Sound, Coanjok Bay, and North River Bar, N. C., 159; Meherrin River, N. C., 160; Pamlico and Tar Rivers, N. C., 161; Yadkin River, N. C., 162; Scuppernong River, N. C., 163; removing sunken vessels or craft obstructing or endangering navigation, 164; examinations and surveys, 164.

In charge of Capt. William H. Bixby, Corps of Engineers—

Contentnea Creek, N. C., 164; Trent River, N. C., 165; Neuse River, N. C., 166; Inland navigation from New Berne to Beaufort Harbor, via Clubfoot, Harlowe, and Newport rivers, N. C., 167; harbor at Beaufort, N. C., 168; New River, N. C., 169; Cape Fear River, above Wilmington, N. C., 170; Cape Fear River, below Wilmington, N. C., 171; Great Pedee River, S. C., 172; Waccamaw River, S. C., 173; harbor at Georgetown, S. C., 174: Santee River, S.C., 175; Wateree River, S. C., 176; examinations and surveys, 177.

In charge of Col. Q. A. Gillmore, Corps of Engineers, Bvt. Maj. Gen., U. S. A.—

Charleston Harbor, S. C., 177; Wappoo Cut, S. C., 179; Ashley River, S. C., 180; Edisto River, S. C., 181; Salkiehatchie River, S. C., Savannah Harbor and River, Ga., 182; Savannah River, Ga., 184; Savannah River above Augusta, Ga., 185; Saint Augustine Creek (Thunderbolt River), Ga., Romerly Marsh, Ga., 186; Altamaha River, Ga., 187; Brunswick Harbor, Ga., 188; entrance to Cumberland Sound, Ga. and Fla., 189; inside passage between Fernandina and Saint John's River, Fla., 191; examinations and surveys, 191.

In charge of Capt. W. T. Rossell, Corps of Engineers—

Saint John's River, Fla., 191; Upper Saint John's River, Fla., Volusia Bar, Fla., 193; Apalachicola Bay, Fla., Tampa Bay, Fla., 194; Suwanee River, Fla., Key West Harbor, Fla., 195; Pease Creek, Fla., harbor at Cedar Keys, Fla., 196; Manatee River, Fla., Caloosahatchee River, Fla., 197; Apalachicola River, Fla., Withlacoochee River, Fla., 198; removing sunken vessels or craft obstructing or endangering navigation, 199; examinations and surveys, 199.

In charge of Capt. R. L. Hoxie, Corps of Engineers—

Ocmulgee River, Ga., 199; Oconee River, Ga., 200; Flint River, Ga., Oostenaula and Coosawattee rivers, Ga., Coosa River, Ga. and Ala., 201; Chattahoochee River, Ga. and Ala., 202; Alabama River, Ala., Tallapoosa River, Ala., 203; Cahaba River, Ala., 204; Escambia and Conecuh rivers, Fla. and Ala., Choctawhatchee River, Fla. and Ala., 205; La Grange Bayou, Fla., harbor at Pensacola, Fla., 206; examinations and surveys, 207.

In charge of Maj. A. N. Damrell, Corps of Engineers—

Mobile Harbor, Ala., 207; Warrior River, Ala., 208; Tombigbee River, from Fulton to Vienna, Tombigbee River, below Vienna, 209; Black Warrior River, from Tuscaloosa to Daniel's Creek, Ala., Old Town Creek, Miss., 210; Noxubee River, Miss., Pascagoula River, Miss., 211; roadstead leading into Back Bay, Biloxi, and Biloxi Channel, Miss., Horn Island Pass, Miss., Pearl River, Miss., below Jackson, 212; Pearl River, Miss., from Jackson to Carthage, Pearl River, Miss., between Edinburg and Carthage, 213; examinations and surveys, 214.

In charge of Maj. W. H. Heuer, Corps of Engineers—

Inspection of the improvement at the South Pass of the Mississippi River, 214; Amite River, La., Tangipahoa River, La., 215; Tchefuncte River, La., 216; Tickfaw River, La., Bayou Teche, La., 217; connecting Bayou Teche with Grand Lake at Charenton, La., 218; Bayou Black, La., 219; Bayou Courtableau, La., 220; Bayou Terrebonne, La., Bayou La Fourche, La., Calcasieu River, La., 221; Calcasieu Pass, La., 222; Sabine Pass, Tex., 223; Sabine River, La. and Tex., 224; Neches River, Tex., removing sunken vessels or craft obstructing or endangering navigation, 225; examinations and surveys, 225.

In charge of Maj. S. M. Mansfield, Corps of Engineers, Bvt. Lieut. Col., U. S. A.—

Entrance to Galveston Harbor, Tex., ship-channel in Galveston Bay, Tex., 226; Trinity River, Tex., Buffalo Bayou, Tex., 227; channel over the bar at mouth of Brazos River, Tex., Pass Cavallo Inlet to Matagorda Bay, Tex., 228; Aransas Pass and Bay up to Rockport and Corpus Christi, Tex., harbor at Brazos Santiago, Tex., 229; protection of river bank at Fort Brown, Tex., 230.

WESTERN RIVERS.

In charge of Capt. Eric Bergland, Corps of Engineers—

Red River, La. and Ark., 230; survey of Bayou Pierre, La., Cypress Bayou, Tex. and La., 232; Cane River, La., Loggy Bayou, Lake Bisteneau and the Dorcheat, La., 233; Ouachita and Black rivers, Ark. and La., 234; Bayou Bartholomew, La. and Ark., Bayou Bœuf, La., 235; Tensas River and Bayou Macon, La., Bayou D'Arbonne, La., 236; Yazoo River, Miss., 237; Big Sunflower River, Miss., Tchula Lake, Miss., 238; Tallahatchee River, Miss., 239; Coldwater River, Miss., Yallabusha River, Miss., 240; Steele's Bayou, Miss., Big Black River, Miss., 241; Big Hatchee River, Tenn., South Forked Deer River, Tenn., 242; Water-gauges on the Mississippi River and its principal tributaries, 243; examinations and surveys, 243.

In charge of Capt. H. S. Taber, Corps of Engineers—

Removing obstructions in Arkansas River, Ark., 244; Arkansas River between Fort Smith and Wichita, Kans., Arkansas River at Fort Smith, Ark., Arkansas River at Pine Bluff, Ark., 245; Black River, Ark. and Mo., 247; White River, Ark., White River above Buffalo Shoals, Ark., 248; White River between Jacksonport and Buffalo Shoals, White and Saint Francis rivers, Ark., Saint Francis River, Ark., 249; Saline River, Ark., 250; L'Anguille River, Ark., 251; survey of Arkansas River, Ark., from Little Rock to its mouth; continuation of survey of Arkansas River from Wichita, Kans., to Fort Gibson, Ind. T., 251; examinations and surveys, 252.

In charge of Maj. A. M. Miller, Corps of Engineers—

Removing snags and wrecks from the Mississippi and Missouri rivers, 252; Osage River, Kans. and Mo., Gasconade River, Mo., 254; Wabash River, Ind. and Ill., 255; White River, Ind., 257; examinations and surveys, 257.

Mississippi River Commission..... 258

Missouri River Commission..... 258

In charge of Maj. O. H. Ernst, Corps of Engineers—

Mississippi River, between the Illinois and Ohio rivers, harbor and Mississippi River at Alton, Mississippi River opposite the city of Saint Louis, Mo., Mississippi River at or near Cape Girardeau, Mo., and Minton Point, Ill., 259; examinations, 259.

In charge of Capt. James B. Quinn, Corps of Engineers—

Yellowstone River, Mont. and Dak., 259; Missouri River from Sioux City to Fort Benton, Mont., 260.

In charge of Maj. Alexander Mackenzie, Corps of Engineers—

Upper Mississippi River, operations of snag-boat, &c., 560; Mississippi River from Saint Paul to the Des Moines Rapids, Mississippi River from Des Moines Rapids to mouth of Illinois River, 261; harbors of refuge on Lake Pepin, removal of bar in Mississippi River opposite Dubuque, Iowa, ice harbor at Dubuque, Iowa, 262; Rock Island Rapids, Mississippi River, harbor at Rock Island, Ill., Des Moines Rapids, Mississippi River, 263; operating and care of Des Moines Rapids Canal, 264; dry dock at the Des Moines Rapids Canal, Quincy Bay, Ill., removing obstructions in Mississippi River, 265; examinations and surveys, 265.

In charge of Maj. Charles J. Allen, Corps of Engineers—

Preservation of Falls of Saint Anthony, Minn., 266; Mississippi River above the Falls of Saint Anthony, Minn., 267; construction of lock and dam on Mississippi River at Meeker's Island, Minn., Chippewa River, Wis., 268; Chippewa River at Yellow Banks, Wis., Saint Croix River below Taylor's Falls, Minn. and Wis., 269; Minnesota River, Minn., Red River of the North, Minn. and Dak., 270; lock and dam at Goose Rapids on Red River of the North, Minn. and Dak., 271; reservoirs upon the headwaters of the Mississippi River and its tributaries, 272; surveys for reservoirs at the sources of the Mississippi, Saint Croix, Chippewa, and Wisconsin rivers, 273.

In charge of Maj. William R. King, Corps of Engineers—

Tennessee River, 273; Cumberland River, Tenn. and Ky., 274; Hiwassee River, French Broad River, Tenn., 276; Clinch River, Tenn., Duck River, Tenn., 277; Caney Fork River, Tenn., Little Tennessee River, Tenn., 278; South Fork Cumberland River, Ky., 279; examinations and surveys, 279.

In charge of Lieut. Col. William E. Merrill, Corps of Engineers, Bvt. Col., U. S. A.—

Ohio River, Davis Island Movable Dam, 280; operating and care of Louisville and Portland Canal, 281; falls of the Ohio River at Louisville, Ky., Monongahela River, W. Va. and Pa., lock and dam No. 9, Monongahela River, 282; Allegheny River, Pa., ice harbor at mouth of Muskingum River, Ohio, 283; harbor of refuge near Cincinnati, Ohio, harbor of refuge mouth Great Kanawha River, W. Va., 284; examinations and surveys, 284.

In charge of Lieut. Col. W. P. Craighill, Corps of Engineers—

Great Kanawha River, W. Va., 285; Elk River, W. Va., 286; New River from mouth of Wilson, in Grayson County, Va., to mouth of Greenbrier River, W. Va., 287; examination of models and plans for movable dams, 288; examination, 288.

In charge of Capt. James C. Post Corps of Engineers—

Kentucky River, Ky., 288; operating and keeping in repair locks and dams on Kentucky River, Ky., Tradewater River, Ky., 289; Big Sandy River, W. Va. and Ky., Guyandotte River, W. Va., 290; Little Kanawha River, W. Va., Buckhannon River, W. Va., 291; examination, 292.

BRIDGING NAVIGABLE WATERS OF THE UNITED STATES.

Bridge across Detroit River, between Belle Isle and the American shore; bridge across Willamette River at Portland, Oreg., 292; bridge across Monongahela River, near Fairmont, W. Va., bridge of the Northern Pacific R. R. Co. across Saint Louis River, Minn. and Wis., 293.

LAKE HARBORS AND RIVERS.

In charge of Maj. Charles J. Allen, Corps of Engineers—

Harbor at Duluth, Minn., dredging Superior Bay, Wis., 294; harbor at Grand Marais, Minn., 295; examinations and surveys, 296.

In charge of Lieut. Col. J. W. Barlow, Corps of Engineers—

Ontonagon Harbor, Mich., 296; Eagle Harbor, Mich., Marquette Harbor, Mich., 297; harbor of refuge at Grand Marais, Mich., 298; Manistique Harbor, Mich., harbor at mouth of Cedar River, Mich., Menomonee Harbor, Mich., and Wis., 299; Oconto Harbor, Wis., 300; Pensaukee Harbor, Wis., 301; Green Bay Harbor, Wis., harbor of refuge at entrance of Sturgeon Bay Canal, Wis., 302; Ahnepee Harbor, Wis., Kewaunee Harbor, Wis., 303; Two Rivers Harbor, Wis., 304; Manitowoc Harbor, Wis., Sheboygan Harbor, Wis., 305; Port Washington Harbor, Wis., 306; examinations and surveys, 307.

In charge of Capt. W. L. Marshall, Corps of Engineers—

Harbor of refuge, Milwaukee Bay, Wis., 307; Milwaukee Harbor, Wis., Racine Harbor, Wis., 308; Kenosha Harbor, Wis., Waukegan Harbor, Ill., 309; Fox and Wisconsin rivers, Wis., 310.

In charge of Maj. W. H. H. Benyaurd, Corps of Engineers—

Chicago Harbor, Ill., 312; Calumet River, Ill., Illinois River, Ill., 313; Calumet Harbor, Ill., surveys for the Hennepin Canal and enlargement of the Illinois and Michigan Canal, 314; examinations and surveys, 314.

In charge of Capt. D. W. Lockwood, Corps of Engineers—

Charlevoix Harbor, Mich., Frankfort, Harbor, Mich., 315; harbor of refuge at Portage Lake, Mich., Manistee Harbor, Mich., 316; Ludington Harbor, Mich., 317; Pentwater Harbor, Mich., White River Harbor, Mich., 318; Muskegon Harbor, Mich., Grand Haven Harbor, Mich., 319; Grand River, Mich., Black Lake Harbor, Mich., 320; Saugatuck Harbor, Mich., South Haven Harbor, Mich., Saint Joseph Harbor, Mich., 321; New Buffalo Harbor, Mich., Michigan City Harbor, Ind., 322; examination, 324.

In charge of Lieut. Col. O. M. Poe, Corps of Engineers, Bvt. Brig. Gen., U. S. A.—

Hay Lake Channel, Saint Mary's River, Mich., 324; Saint Mary's Falls Canal and River, Mich., operating and care of Saint Mary's Falls Canal, Mich., 325; dry dock at Saint Mary's Falls Canal, Mich., harbor at Cheboygan, Mich, 326; harbor at Thunder Bay, Mich., harbor at Au Sable, Mich., Saginaw River, Mich., 327; harbor of refuge, Sand Beach, Lake Huron, Mich., 328; ice-harbor of refuge, Belle River, Mich., repairs of Saint Clair Flats Canal, Mich., 329; operating and care of Saint Clair Flats Ship-Canal, Mich., Clinton River, Mich., 330; Detroit River, Mich., 331; examinations and surveys, 332.

In charge of Maj. L. Cooper Overman, Corps of Engineers—

Monroe Harbor, Mich., 332; Toledo Harbor, Ohio, 333; Port Clinton Harbor, Ohio, 334; Sandusky City Harbor, Ohio, 335; Sandusky River, Ohio, Huron Harbor, Ohio, 337; Vermillion Harbor, Ohio, 338; Mouth of Black River, Ohio, Rocky River, Ohio, 339; Cleveland Harbor, Ohio, 340: Fairport Harbor, Ohio, 341; Ashtabula Harbor, Ohio, 342; Conneaut Harbor, Ohio, Dunkirk Harbor, N. Y., 343; examination, 344.

In charge of Capt. Edward Maguire, Corps of Engineers—

Erie Harbor, Pa., 344; Buffalo Harbor, N. Y., 345; Niagara River, N. Y., Wilson Harbor, N. Y., 346; Olcott Harbor, N. Y., Oak Orchard Harbor, N. Y., 347; Charlotte Harbor, N. Y., 348; Pultneyville Harbor, N. Y., Great Sodus Harbor, N. Y., 349; Little Sodus Harbor, N. Y., Oswego Harbor, N. Y., 350; Sackett's Harbor, N. Y., 352; examinations and surveys, 352.

In charge of Maj. Milton B. Adams, Corps of Engineers—

Ogdensburg Harbor, N. Y., Grass River, N. Y., 353; breakwater at Rouse's Point, Lake Champlain, N. Y., Swanton Harbor, Vt., 354; Plattsburg Harbor, N. Y., Burlington Harbor, Vt., 355; Otter Creek, Vt., Ticonderoga River, N. Y., 356; examinations and surveys, 357.

PACIFIC COAST.

In charge of Lieut. Col. George H. Mendell, Corps of Engineers—

Oakland Harbor, Cal., 357; Wilmington Harbor, Cal., Redwood Harbor, Cal., 358; Petaluma Creek, Cal., removal of sunken vessels or craft obstructing or endangering navigation, 359; examinations and surveys, 360.

In charge of Col. C. Seaforth Stewart, Corps of Engineers—

Harbor at San Diego, Cal., 360.

In charge of Capt. A. H. Payson, Corps of Engineers—

Humboldt Bay, Cal., San Joaquin River, Cal., 361; Mokelumne River, Cal., Sacramento and Feather rivers, Cal., 362; Colorado River, Nev., Cal., and Ariz., 363; examination, 363.

In charge of Capt. Charles F. Powell, Corps of Engineers—

Columbia and Willamette rivers, below Portland, Oreg., mouth of Columbia River, Oreg. and Wash., 364; entrance to Coos Bay, Oreg., entrance to Yaquina Bay, Oreg., 365; mouth of Coquille River, Oreg., 366; Skagit, Steilaquamish, Nootsack, Snohomish, and Snoqualmie rivers, Wash., Chehalis River, Wash., 367; gauging waters of Columbia River and principal tributaries, 368; examination, 368.

In charge of Maj. W. A. Jones, Corps of Engineers—

Upper Willamette River, Oreg., 369; Columbia River at the Cascades, Oreg., Upper Columbia and Snake rivers, Oreg. and Wash., 370; Cowlitz River, Wash., Lower Clearwater River, Idaho, 371; examinations and surveys, 371.

EXAMINATIONS, SURVEYS, AND CONTINGENCIES OF RIVERS AND HARBORS.

Estimate for 1886–'87 372

WASHINGTON AQUEDUCT, ETC.

In charge of Maj. G. J. Lydecker, Corps of Engineers—

Washington Aqueduct, 372; increasing water supply to city of Washington, 373; erection of fishways at Great Falls of the Potomac, 374.

PUBLIC BUILDINGS, GROUNDS, ETC., DISTRICT OF COLUMBIA.

In charge of Lieut. Col. John M. Wilson, Corps of Engineers, Colonel, United States Army 374

PRINTING AND DISTRIBUTION OF CHARTS OF THE NORTHERN AND NORTHWESTERN LAKES 375

MILITARY AND GEOGRAPHICAL MAPS 375

GEOGRAPHICAL SURVEYS WEST OF THE 100TH MERIDIAN.

In charge of Capt. George M. Wheeler, Corps of Engineers 376

RECONNAISSANCES AND EXPLORATIONS.

Officers on duty at headquarters of the Army, of divisions, and departments, 377; reports made, 377, 378; estimate for surveys and reconnaissances and publications of maps, 378.

OFFICE OF THE CHIEF OF ENGINEERS.

Officers of the Corps of Engineers in charge of Divisions 378

STATEMENT OF RANK AND DUTIES OF OFFICERS OF THE CORPS OF ENGINEERS DURING THE FISCAL YEAR 379

LAWS AFFECTING THE CORPS OF ENGINEERS, 48TH CONGRESS, 2D SESSION, 1884–'85 401

APPENDIX No. 1.

REPORT OF CAPT. W. H. BIXBY, CORPS OF ENGINEERS.

Preparation of report upon investigations in Europe in 1881–'82 421

APPENDIX No. 2.

REPORT OF LIEUT. COL. GEORGE H. ELLIOT, CORPS OF ENGINEERS.

Fort Greene, Newport Harbor, R. I 423

APPENDIXES Nos. 3 and 4.

REPORT OF LIEUT. COL. H. L. ABBOT, CORPS OF ENGINEERS, BVT. BRIG. GEN., U. S. A.

No. 3. Battalion of Engineers and Engineer School of Application ... 427
No. 4. Engineer Depot and Post at Willets Point 457

RIVERS AND HARBORS, ETC.

APPENDIX A.

REPORT OF COL. CHARLES E. BLUNT, CORPS OF ENGINEERS.

IMPROVEMENTS.—Lubec Channel, Me, 462; Bangor Harbor and Penobscot River, Me., 464; Moose-a-bec Bar at Jonesport, Me., 465; Belfast Harbor, Me., Rockland Harbor, Me., 467; Portland Harbor, Me., 469; Kennebunk River, Me., 470; breakwater at mouth of Saco River, Me., 471; Portsmouth Harbor, N. H., 472; Cocheco River, N. H., 474.

EXAMINATIONS AND SURVEYS.—Southern entrance to Owl's Head Harbor, Me., 476; harbor at Portsmouth, N. H., from the sea to the wharf, 478; Winnipiseogee Lake, N. H., at a point called "The Weirs," 479; Little Harbor at Portsmouth, N. H., with a view to its improvement as a harbor of refuge, 480; York Harbor, Me., 485; Wood Island Harbor, Me., 489.

APPENDIX B.

REPORT OF MAJ. CHARLES W. RAYMOND, CORPS OF ENGINEERS.

IMPROVEMENTS.—Newburyport Harbor, Mass., 494; Merrimac River, Mass., 499; Scituate Harbor, Mass., 501; Boston Harbor, Mass., 502; Plymouth Harbor, Mass., 510; Provincetown Harbor, Mass., 513; Lynn Harbor, Mass., 516; Malden River, Mass., 519; harbor of refuge at Sandy Bay, Cape Ann, Mass., 520.

EXAMINATIONS AND SURVEYS.—Harbor at Marblehead, Mass., for repair of sea-wall; harbor at Salem, Mass., with a view to building a jetty running out from the mainland to deep water, 537; channel from Goose Point, in Plymouth Harbor, Mass., to the wharf of the Cordage Company, 538; harbor at Gloucester, Mass., with a view to the removal of rock obstructions, 540; Fort Point Channel, Boston Harbor, 543; Powow River, Mass., 549; Hingham Harbor, Mass., 553.

APPENDIX C.

REPORT OF LIEUT. COL. GEORGE H. ELLIOT, CORPS OF ENGINEERS.

IMPROVEMENTS.—Harbor of refuge at Hyannis, Mass., 560; harbor of refuge at Nantucket, Mass., 561; Wood's Holl and harbor of refuge at Wood's Holl, Mass., 580; Wareham Harbor, Mass., 585; Taunton River, Mass., 588; Pawtucket River, R. I., 592; Providence River and Narragansett Bay, R. I., 596; Newport Harbor, R. I., 603; harbor of refuge at Block Island, R. I., 606; Little Narragansett Bay, R. I. and Conn., 615; harbor of refuge at Stonington, Conn., 616.

EXAMINATIONS AND SURVEYS.—Harbor at Hyannis, Mass., with a view of deepening the harbor, 619; Pawcatuck River, R. I., 622; Warren River, R. I., with a view to the removal of obstructions from the channel, 625.

APPENDIX D.

REPORT OF LIEUT. COL. WALTER McFARLAND, CORPS OF ENGINEERS.

IMPROVEMENTS.—Connecticut River, Mass. and Conn., 632; Thames River, Conn., 638; New London Harbor, Conn., 641; Clinton Harbor, Conn., 643; New Haven Harbor, Conn., 644; breakwater at New Haven Harbor, Conn., 646; Milford Harbor, Conn., 648; Housatonic River, Conn., 649; Bridgeport Harbor, Conn., 651; Black Rock Harbor, Conn., 653; Southport Harbor, Conn., 655; Norwalk Harbor, Conn., 656; Port Chester Harbor, N. Y., 658; New Rochelle Harbor, N. Y., 660; Echo Harbor, New Rochelle, N. Y., 661; Mamaroneck Harbor, N. Y., 662; Greenport Harbor, N. Y., 664; Port Jefferson Harbor, N. Y., 665; Flushing Bay, N. Y., 666; Newtown Creek, N. Y., 668; Buttermilk Channel, N. Y., 670; Gowanus Bay, N. Y., 672; Harlem River, N. Y., 674; Hudson River, N. Y., 677; Harbor at Rondout, N. Y., 697; Harbor at Saugerties, N. Y., 699; removing sunken vessels or craft obstructing or endangering navigation, 700.

EXAMINATIONS AND SURVEYS.—Horton's Point, N.Y., near Dutch [Duck] Pond Point, for breakwater, 701; Huntington Harbor, N. Y., 703; breakwater at Falkner's Island, Conn., 707; river and harbor at Niantic, Conn., 710; Hudson River, from Troy to mouth of canal, N. Y., 711.

APPENDIX E.

REPORT OF BRIG. GEN. JOHN NEWTON, CHIEF OF ENGINEERS, BVT. MAJ. GEN., U. S. A.

IMPROVEMENT.—Removing obstructions in East River and Hell Gate, N. Y., 715.

APPENDIX F.

REPORT OF MAJ. GEORGE L. GILLESPIE, CORPS OF ENGINEERS, BVT. LIEUT. COL., U. S. A.

IMPROVEMENTS.—East Chester Creek, N. Y., 738; Canarsie Bay, N. Y., 739; Sheepshead Bay, N. Y., 740; Sumpawanus Inlet, N. Y., 742; Cheesequakes Creek, N. J., 743; Passaic River, above Newark, N. J., 744; Passaic River, below Newark, and removing shoals in Newark Bay, N. J., 746; channel between Staten Island and New Jersey, 749; Shrewsbury River, N. J., 751; Rahway River, N. J., 753; Elizabeth River, N. J., Woodbridge Creek, N. J., 754; Manasquan River, N. J., 756; Raritan Bay, N. J., 757; Raritan River, N. J., 759; Mattawan Creek, N. J., Keyport Harbor, N. J., 763; South River, N. J., 764; Gedney's Channel, New York Harbor, 766; removing sunken vessels or craft obstructing or endangering navigation, 787.

EXAMINATIONS AND SURVEYS.—Baldwin River, N. Y., at Baldwin Station, to connect with Long Branch, 789; Hudson River, on the New Jersey side, from Weehawken to Bergen Point, Hudson County, N. J., with a view to deepening the water at the wharf on that side, 790.

APPENDIX G.

REPORT OF LIEUT. COL. HENRY M. ROBERT, CORPS OF ENGINEERS.

IMPROVEMENTS.—Delaware River, from Trenton, N. J., to its mouth, 798; Delaware River, between Trenton, N. J., and Bridesburg, Pa., 833; Delaware River, below Bridesburg, Pa., 834; Delaware River, at Schooner Ledge, 835; Delaware River, near Cherry Island Flats, Frankford Creek, Pa., 836; Schuylkill River, 837; ice-harbor at Marcus Hook, Pa., 839; ice-harbor at the head of Delaware Bay, Del., 840; construction of iron pier in Delaware Bay, near Lewes, Del., 845; Delaware Breakwater Harbor, Del., 846; Rancocas River, N. J., 849; Woodbury Creek, N. J., Mantua Creek, N. J., 850; Raccoon River, N. J., 851; Salem River, N. J., 852; Cohansey Creek, N. J., 853; north branch of Susquehannah River, Pa., 854; removal of wrecks from Delaware Bay and River, removing sunken vessels or craft obstructing or endangering navigation, 855; United States commission advisory to the board of harbor commissioners of Philadelphia, Pa., 857.

EXAMINATIONS.—Corson's Sound and Townsend Inlet, N. J., 858; mouth of Salem River, N. J., 860; harbor of Atlantic City, at Absecom Inlet, N. J., 862; west branch of the Susquehanna River, Pa., between Salt Lick and Buttermilk Falls, 864.

APPENDIX H.

REPORT OF MR. WILLIAM F. SMITH, UNITED STATES AGENT.

IMPROVEMENTS.—Maurice River, N. J., 868; Wilmington Harbor, Del., 869; ice-harbor at New Castle, Del., 872; Duck Creek, Del., 876; Saint Jones River, Del., 877; Mispillion Creek, Del., 878; Broadkiln River, Del., 879; Broad Creek, Del., from its mouth to Laurel, 880; Indian River, Del., 881; Susquehanna River above and below Havre de Grace, Md., 882; Elk River, Md., 883; Chester River at Kent Island Narrows, Md., Chester River from Sprye's Landing to Crumpton, Md., Corsica Creek, Md., 884; harbor at Annapolis, Md., Choptank River, Md., 886; harbor of Cambridge, Md., Wicomico River, Md., 888; Upper Thoroughfare, between Deil's Island and the mainland, Md., 889; removing sunken vessels or craft obstructing or endangering navigation, 890.

EXAMINATIONS AND SURVEYS.—Harbor at Easton Point, Md., commencing at a point on Tread Haven River where the Government work on the channel of said river was recently suspended, 890; Lewes Creek and Rehoboth Bay, Del., Assateague and Chincoteauge bays, Md., with a view to form continuous inland navigation from Chincoteague Bay, in Virginia, to Delaware Bay, at or near Lewes, Del., 891; Pocomoke River and Sound, Md., 904; Skipton Creek, Md., 907; Tuckahoe Creek, Md., 908; Sassafras River, Md., above Georgetown, 912.

PART II.

APPENDIX I.

REPORT OF LIEUT. COL. WILLIAM P. CRAIGHILL, CORPS OF ENGINEERS.

IMPROVEMENT.—Patapsco River and channels to Baltimore, Md., 917.

APPENDIX J.

REPORT OF MAJ. PETER C. HAINS, CORPS OF ENGINEERS, BVT. LIEUT. COL., U. S. A.

IMPROVEMENTS.—Harbors at Washington and Georgetown, D. C., 923; Potomac River at Washington, D. C., 926; James River, Va., 944; Shenandoah River, W. Va., 957.

APPENDIX K.

REPORT OF MR. S. T. ABERT, UNITED STATES AGENT.

IMPROVEMENTS.—Channel at Mount Vernon, Va., Neabsco Creek, Va., 962; Breton Bay, Leonardtown, Md., 964; Nomini Creek, Va., 966; harbor at entrance of Saint Jerome's Creek, Md., 968; Rappahannock River, Va., 971; Totusky River, Va., 976; Urbana Creek, Va., 977; Mattaponi River, Va., 979; Pamunky River, Va., 982; York River, Va., 984; Chickahominy River, Va., 987; Staunton River, Va., 989, 992; Dan River, between Madison, N. C., and Danville, Va., 993; Roanoke River, N. C., 995; French Broad River, N. C., 997.
EXAMINATIONS AND SURVEYS.—Cockpit Point, Va., for ice-harbor, 999; Colonial Beach, formerly White Point, in county of Westmoreland, Va., 1001.

APPENDIX L.

REPORT OF CAPT. F. A. HINMAN, CORPS OF ENGINEERS.

IMPROVEMENTS.—Harbor at Norfolk, Va., 1008; approach to Norfolk Harbor and the United States (Norfolk) navy-yard, between Lambert's Point and Fort Norfolk, Va., 1017; Appomattox River, Va., 1029; Nottoway River, Va., Blackwater River, Va., 1033; Archer's Hope River, Va., 1034; North Landing River, Va and N. C., 1035; Edenton Bay, N. C., 1038; Currituck Sound, Coanjok Bay, and North River Bar, N. C., 1039; Meherrin River, Pamplico and Tar rivers, N. C., 1041; Yadkin River, N. C., 1042; Scuppernong River, N. C., removing sunken vessels or craft obstructing or endangering navigation, 1044.
EXAMINATIONS AND SURVEYS.—Perquiman's River above Hartford [Hertford], N. C., 1045; Green River, N. C., 1046; Pasquotank River, N. C., above mouth of canal, 1049; Cashie River, from its mouth to the town of Windsor, in Bertie County, N. C., 1053.

APPENDIX M.

REPORT OF CAPT. WILLIAM H. BIXBY, CORPS OF ENGINEERS.

IMPROVEMENTS.—Contentnea Creek, N. C., 1060; Trent River, N. C., 1062; Neuse River, N. C., 1065; inland navigation from New Berne to Beaufort Harbor, via Clubfoot, Harlowe, and Newport rivers, N. C., 1070; harbor at Beaufort, N. C., 1076; New River, N. C., 1082; Cape Fear River above Wilmington, N. C., 1083; Cape Fear River below Wilmington, N. C., 1087; Great Pedee River, S. C., 1100; Waccamaw River, S. C., 1105; harbor at Georgetown, S. C., 1114; Santee River, S. C., 1119; Wateree River, S. C., 1123.

EXAMINATIONS AND SURVEYS.—Northeast Branch of Cape Fear River, N. C., 1128; Bogue Sound, N. C., between New River, and Beaufort, 1133; Congaree River, S. C., 1140; Black River, N. C., 1145; entrance to Winyaw Bay, near Georgetown, S. C., 1154.

APPENDIX N.

REPORT OF COL. Q. A. GILLMORE, CORPS OF ENGINEERS, BVT. MAJ. GEN., U. S. A.

IMPROVEMENTS.—Charleston Harbor, S. C., 1172; Wappoo Cut, S. C., 1186; Ashley River, S. C., 1188; Edisto River, S. C., 1190; Salkiehatchie River, S. C., 1192; Savannah Harbor and River, Ga., 1195; Savannah River, Ga., 1207; Savannah River above Augusta, Ga., 1213; Saint Augustine Creek (Thunderbolt River), Ga., 1214; Romerly Marsh, Ga., 1215; Altamaha River, Ga., 1218; Brunswick Harbor, Ga., 1224; entrance to Cumberland Sound, Ga. and Fla., 1229; inside passage beween Fernandina and Saint John's River, Fla., 1234.
EXAMINATIONS AND SURVEYS.—Altamaha River, Ga., from Darien to its mouth, 1234; Darien Harbor, Ga., 1237.

APPENDIX O.

REPORT OF CAPT. WILLIAM T. ROSSELL, CORPS OF ENGINEERS.

IMPROVEMENTS.—Saint John's River, Fla., 1243; Upper Saint John's River, Fla, 1253; Volusia Bar, Fla., 1254; Apalachicola Bay, Fla., 1258; Tampa Bay, Fla., 1262; Suwanee River, Fla., 1265; Key West Harbor, Fla., 1267; Pease Creek, Fla., 1268; harbor at Cedar Keys, Fla., 1270; Manatee River, Fla., 1272; Caloosahatchee River, Fla., 1273; Apalachicola River, Fla., 1275; Withlacoochee River, Fla., 1277; removing sunken vessels or craft obstructing or endangering navigation, 1279.
EXAMINATIONS AND SURVEYS.—Anclote Harbor, Fla, 1280; Wekiva River, Fla., 1281; Saint Augustine Harbor, Fla., 1282; Amelia River, Fla., 1284; Charlotte Harbor, Fla., 1286; Mosquito Inlet, Fla., 1287; for canal and inland communication from Saint John's River through Mosquito Lagoon and Indian River to Jupiter Inlet and Lake Worth, Fla., 1291.

APPENDIX P.

REPORT OF CAPT. R. L. HOXIE, CORPS OF ENGINEERS.

IMPROVEMENTS.—Ocmulgee River, Ga., 1295; Oconee River, Ga., 1297; Flint River, Ga., 1298; Oostenaula and Coosawattee rivers, Ga., 1300; Coosa River, Ga. and Ala., 1301; Chattahoochee River, Ga. and Ala., 1303; Alabama River, Ala., 1306; Tallapoosa River, Ala., 1307; Cahaba River, Ala., 1308; Escambia and Conecuh rivers, Fla. and Ala., 1309; Choctawhatchee River, Fla. and Ala., 1311; Bayou La Grange, Fla., 1312; harbor at Pensacola, Fla., 1313.
EXAMINATIONS AND SURVEYS.—Outer and inner bars at the entrance of Pensacola Harbor, Fla., 1316; Clearwater Harbor, Fla., 1323; Upper Oconee River, Ga., from Skull Shoals to the Georgia railroad bridge, 1329.

APPENDIX Q.

REPORT OF MAJ. A. N. DAMRELL, CORPS OF ENGINEERS.

IMPROVEMENTS.—Mobile Harbor, Ala., 1336; Warrior River, Ala., 1345; Tombigbee River, from Fulton to Vienna, 1351; Tombigbee River, below Vienna, 1350; Black Warrior River, from Tuscaloosa to Daniel's Creek, Ala., 1354; Old Town Creek, Miss., 1355; Noxubee River, Miss., 1356; Pascagoula River, Miss., 1358; roadstead leading into Back Bay, Biloxi, and Biloxi Channel, Miss., 1360; Horn Island Pass, Miss., 1361; Pearl River, Miss., below Jackson, 1363; Pearl River, Miss., from Jackson to Carthage, 1369; Pearl River, Miss., between Edinburg and Carthage, 1371.
EXAMINATIONS AND SURVEYS.—Homosassa Bay, Fla., Back Bay at Handsborough, Miss., 1373; Mobile River and Harbor, from lower anchorage up to the northern limits of the city of Mobile, with a view to securing 23 feet depth of water, 1374.

APPENDIX R.

REPORT OF MAJ. W. H. HEUER, CORPS OF ENGINEERS.

INSPECTION.—Improvement at the South Pass of the Mississippi River, 1377.

APPENDIX S.

REPORT OF MAJ. W. H. HEUER, CORPS OF ENGINEERS.

IMPROVEMENTS.—Amite River, La., 1391; Tangipahoa River, La., 1393; Tchefuncte River, La., 1394; Tickfaw River, La., 1396; Bayou Teche, La., 1397; connecting Bayou Teche with Grand Lake at Charenton, La., 1399; Bayou Black, La., 1400; Bayou Courtableau, La., 1403; Bayou Terrebonne, La., 1407; Bayou La Fourche, La., 1408; Calcasieu River, La., 1409; Calcasieu Pass, La., 1414; Sabine Pass and Blue Buck Bar, Tex., 1415; Sabine River, La. and Tex., 1425; Neches River, Tex., 1426; removing sunken vessels or craft obstructing or endangering navigation, 1427.

EXAMINATIONS AND SURVEYS.—Homochitto River, Miss., 1429; Buffalo River, Miss., 1430; Bayou Plaquemine, La., 1431; Atchafalaya River, La., above Berwick Bay, 1432; Bayou Pierre, Miss., 1439; Natalbany River, La., 1446.

APPENDIX T.

REPORT OF MAJ. S. M. MANSFIELD, CORPS OF ENGINEERS, BVT. LIEUT. COL., U. S. A.

IMPROVEMENTS.—Entrance to Galveston Harbor, Tex., 1449; ship-channel in Galveston Bay, Tex., 1454; Trinity River, Tex., 1455; Buffalo Bayou, Tex., 1457; channel over the bar at mouth of Brazos River, Tex., 1460; Pass Cavallo Inlet to Matagorda Bay, Tex., 1462; Aransas Pass and Bay, up to Rockport and Corpus Christi, Tex., 1464; harbor at Brazos Santiago, Tex., 1468; protection of river bank at Fort Brown, Tex., 1470.

APPENDIX U.

REPORT OF CAPT. ERIC BERGLAND, CORPS OF ENGINEERS.

IMPROVEMENTS.—Red River, La. and Ark., 1472; survey of Bayou Pierre, La., 1487; Cypress Bayou, Tex. and La., 1493; Cane River, La., 1495; Loggy Bayou, Lake Bisteneau and the Dorcheat, La., 1496; Ouachita and Black rivers, Ark. and La., 1497; Bayou Bartholomew, La. and Ark., 1501; Bayou Bœuf, La., 1502; Tensas River and Bayou Maçon, La., 1504; Bayou D'Arbonne, La., 1505; Yazoo River, Miss., 1507; Big Sunflower River, Miss., 1511; Tchula Lake, Miss., 1514; Tallahatchee River, Miss., 1517; Coldwater River, Miss., 1518; Yallabusha River, Miss., 1519; Steele's Bayou, Miss., 1522; Big Black River, Miss., 1524; Big Hatchee River, Tenn., 1527; South Forked Deer River, Tenn., 1529; water-gauges on the Mississippi River and its principal tributaries, 1532.

EXAMINATIONS AND SURVEYS.—Cassidy's Bayou, Miss., 1534; Yazoo Pass, Miss., to determine the cost of a lock at that place, 1537: Deer Creek, Miss., 1538; outlets of Bœuf River, La., with a view to closing same, 1545; Bayou Bartholomew, Ark., from present head of navigation to Lincoln County line, 1548; Cypress Bayou and the lakes between Jefferson, Tex., and Shreveport, La., 1552.

APPENDIX V.

REPORT OF CAPT. H. S. TABER, CORPS OF ENGINEERS.

IMPROVEMENTS.—Removing obstructions in Arkansas River, Ark., 1558; Arkansas River between Fort Smith and Wichita, Kans., 1561; Arkansas River at Fort Smith, Ark., 1563; Arkansas River at Pine Bluff, Ark., 1564; Black River, Ark. and Mo., 1583; White River, Ark., 1586; White River above Buffalo Shoals, Ark., 1591; White River between Jacksonport and Buffalo Shoals, 1593; White and Saint Francis rivers, Ark., 1594; Saint Francis River, Ark., 1595; Saline River, Ark., 1598; L'Anguille River, Ark., 1600.

EXAMINATIONS AND SURVEYS.—Survey of Arkansas River from Little Rock to its mouth, 1601; continuation of survey of Arkansas River from Wichita, Kans., to Fort Gibson, Ind. T., 1611; Little Red River, Ark., 1612; Red River above Fulton, Ark., 1617; Petit Jean River, Ark., 1627.

APPENDIX W.

REPORT OF MAJ. A. M. MILLER, CORPS OF ENGINEERS.

IMPROVEMENTS.—Removing snags and wrecks from the Mississippi and Missouri rivers, 1633, 1652; Osage River, Kans. and Mo., 1636; Gasconade River, Mo., 1637, 1654; Wabash River, Ind. and Ill., 1638; White River, Ind., 1642.

EXAMINATIONS.—Nish-na-botna [Nishnabotana] River, with a view to increasing the depth of channel in the Missouri River, 1643; Kankakee River, Ind., 1645; Wabash River, Ind., from Logansport to Delphi, 1649.

APPENDIX X.

REPORT OF MAJ. O. H. ERNST, CORPS OF ENGINEERS.

IMPROVEMENTS.—Mississippi River between the Illinois and Ohio rivers, 1655; harbor and Mississippi River at Alton, Mississippi River opposite the city of Saint Louis, Mo., Mississippi River at or near Cape Girardeau, Mo., and Minton Point, Ill., 1656.

EXAMINATION.—Osage River, Mo., from mouth to Linn Creek, with a view to movable locks and dams, 1657.

APPENDIX Y.

REPORT OF CAPT. JAMES B. QUINN, CORPS OF ENGINEERS.

IMPROVEMENT.—Yellowstone River, Mont. and Dak., 1659.

PART III.

APPENDIX Z.

REPORT OF MAJ. ALEXANDER MACKENZIE, CORPS OF ENGINEERS.

IMPROVEMENTS.—Upper Mississippi River, operations of snag-boat, &c., 1662; Mississippi River from Saint Paul to the Des Moines Rapids, 1667; Mississippi Rapids from Des Moines Rapids to mouth of Illinois River, 1685; harbors of refuge on Lake Pepin, 1687; removal of bar in Mississippi River opposite Dubuque, Iowa, ice-harbor at Dubuque, Iowa, 1691; Rock Island Rapids, Mississippi River, 1694; harbor at Rock Island, Ill., 1695; Des Moines Rapids, Mississippi River, 1697; operating and care of Des Moines Rapids Canal, 1700; dry-dock at the Des Moines Rapids Canal, 1707; Quincy Bay, Ill., 1709; removing obstructions in Mississippi River, 1710.

EXAMINATIONS AND SURVEYS.—Sny Island Levee, Ill., on the Mississippi River, 1710; bar and obstructions at or near the mouth of Whipple Creek, in Quincy Bay, Ill., 1717; Mississippi River in the vicinity of Guttenberg, Iowa, 1718.

APPENDIX A A.

REPORT OF MAJ. CHARLES J. ALLEN, CORPS OF ENGINEERS.

IMPROVEMENTS.—Preservation of Falls of Saint Anthony, Minn., 1721; Mississippi River above the Falls of Saint Anthony, Minn., 1731; construction of lock and dam on Mississippi River at Meeker's Island, Minn., 1733; Chippewa River, Wis., 1734; Chippewa River at Yellow Banks, Wis., 1737; Saint Croix River below Taylor's Falls, Minn. and Wis., 1738; Minnesota River, Minn., 1741; Red River of the North, Minn. and Dak., 1742; lock and dam at Goose Rapids on Red River of the North, Minn. and Dak., 1745; reservoirs upon the headwaters of the Mississippi River and its tributaries, 1747; surveys for reservoirs at the sources of the Mississippi, Saint Croix, Chippewa, and Wisconsin rivers, 1750.

APPENDIX B B.

REPORT OF MAJ. WILLIAM R. KING, CORPS OF ENGINEERS.

IMPROVEMENTS.—Tennessee River, 1751; Cumberland River, 1760; Hiawassee River, 1764; French Broad River, Tenn., 1765; Clinch River, Tenn., 1766; Duck River, Tenn., Caney Fork River, Tenn., 1768; Little Tennessee River, Tenn., 1769; South Fork Cumberland River, Ky., 1770.

EXAMINATIONS AND SURVEYS.—Elk River, Tenn. and Ala., 1771; Little River, Ky., condition of the Cumberland River above the mouth of the Jellico, in Kentucky, 1772; Holston River, Tenn., 1773; extension of the survey of Caney Fork River to Frank's Ferry, Tenn., 1774.

APPENDIX C C.

REPORT OF LIEUT. COL. WILLIAM E. MERRILL, CORPS OF ENGINEERS, BVT. COL., U. S. A.

IMPROVEMENTS.—Ohio River, 1776; operating and care of Davis Island lock and movable dam, Ohio River, 1802; operating and care of Louisville and Portland Canal, 1803; Falls of the Ohio River at Louisville, Ky., 1811; Monongahela River, W. Va. and Pa., 1813; operating and care of lock and dam No. 9, Monongahela River, 1817; Allegheny River, Pa., 1818; ice-harbor at mouth of Muskingum River, Ohio, 1821; harbor of refuge near Cincinnati, Ohio, 1825; harbor of refuge at mouth of Great Kanawha River, W. Va., 1826.

EXAMINATIONS AND SURVEYS.—Shawneetown Harbor and Levee, Ill., 1828; New Albany Harbor, Ind., and the river and shores adjacent to said harbor, 1829; harbor at Paducah, Ky., 1830; harbor at Owensborough, Ky., 1831; Scioto River, Ohio, 1832; Lawrenceburg Harbor, Ind., 1839; bar in the Ohio River opposite the mouth of the Licking River, Ky., 1843.

APPENDIX D D.

REPORT OF LIEUT. COL. WILLIAM P. CRAIGHILL, CORPS OF ENGINEERS.

IMPROVEMENTS.—Great Kanawha River, W. Va., 1845; Elk River, W. Va., 1857; New River, from the mouth of Wilson, in Grayson County, Va., to the mouth of Greenbrier River, W. Va., examination of models and plans, &c., for movable dams, 1859.

EXAMINATION.—Greenbrier River, W. Va., 1866.

APPENDIX E E.

REPORT OF CAPT. JAMES C. POST, CORPS OF ENGINEERS.

IMPROVEMENTS.—Kentucky River, Ky., 1869: operating and keeping in repair locks and dams on the Kentucky River, Ky., 1878; Tradewater River, Ky., 1883; Big Sandy River, W. Va. and Ky., 1884; Guyandotte River, W. Va., 1889; Little Kanawha River, W. Va., 1890; Buckhannon River, W. Va., 1892.

EXAMINATIONS AND SURVEYS.—Rough River, Ky., 1893, 1894; condition of Green and Barren rivers, Ky., 1904.

APPENDIX F F.

BRIDGING NAVIGABLE WATERS OF THE UNITED STATES.

Bridge across Detroit River between Belle Isle and the American shore, 1917; bridge across Willamette River at Portland, Oreg., 1918; bridge across the Monongahela River near Fairmont, W. Va., 1919; bridge of the Northern Pacific Railroad Company across Saint Louis River, Minn. and Wis., 1925.

APPENDIX G G.

REPORT OF MAJ. CHARLES J. ALLEN, CORPS OF ENGINEERS.

IMPROVEMENTS.—Harbor at Duluth, Minn., 1937; dredging Superior Bay, Wis., 1944; harbor at Grand Marais, Minn., 1949.

EXAMINATIONS AND SURVEYS.—Big Stone Lake and Lake Traverse, Minn., with a view to connecting them, 1951; Agate and Burlington bays, Minn., 1954; Saint Louis Bay and Saint Louis River, from Connor's Point, Wis., and Rice's Point, Minn., to foot of first falls, 1959.

APPENDIX H H.

REPORT OF LIEUT. COL. J. W. BARLOW, CORPS OF ENGINEERS.

IMPROVEMENTS.—Ontonagon Harbor, Mich., 1968; Eagle Harbor, Mich., 1970; Marquette Harbor, Mich., 1971; harbor of refuge at Grand Marais, Mich., 1973; Manistique Harbor, Mich., 1974; harbor at mouth of Cedar River, Mich., 1976; Menomonee Harbor, Mich. and Wis., 1978; Oconto Harbor, Wis., 1982; Pensaukee Harbor, Wis., 1985; Green Bay Harbor, Wis., 1987; harbor of refuge at entrance of Sturgeon Bay Canal, Wis., 1988; Ahnepee Harbor, Wis., 1989; Kewaunee Harbor, Wis., 1993; Two Rivers Harbor, Wis., 1995; Manitowoc Harbor, Wis., 1998; Sheboygan Harbor, Wis., 2001; Port Washington Harbor, Wis., 2003.

EXAMINATIONS AND SURVEYS.—Lac la Belle Harbor, Mich., 2005; Ashland Harbor, Lake Superior, Wis., 2010.

APPENDIX I I.

REPORT OF CAPT. W. L. MARSHALL, CORPS OF ENGINEERS.

IMPROVEMENTS.—Harbor of refuge, Milwaukee Bay, Wis., 2015; Milwaukee Harbor, Wis., 2018; Racine Harbor, Wis., 2019; Kenosha Harbor, Wis., 2021; Waukegan Harbor, Ill., 2023; Fox and Wisconsin rivers, Wis., 2025.

APPENDIX J J.

REPORT OF MAJ. W. H. H. BENYAURD, CORPS OF ENGINEERS.

IMPROVEMENTS.—Chicago Harbor, Ill., 2047; Calumet Harbor, Ill., 2051; Illinois River, 2052; Calumet River, 2055.

EXAMINATIONS AND SURVEYS.—For Hennepin Canal and for the enlargement of the Illinois and Michigan Canal, Wolf Lake, Ind., 2056; for ship-canal from Calumet River to Lake Calumet, Ill., 2057; Calumet River, Ill., from a point half a mile east of Hammond to the forks of the river, 2059.

APPENDIX K K.

REPORT OF CAPT. D. W. LOCKWOOD, CORPS OF ENGINEERS.

IMPROVEMENTS.—Charlevoix Harbor, Mich., 2065; Frankfort Harbor, Mich., 2068; harbor of refuge at Portage Lake, Mich., 2069; Manistee Harbor, Mich., 2071; Ludington Harbor, Mich., 2072; Pentwater Harbor, Mich., 2075; White River Harbor, Mich., 2076; Muskegon Harbor, Mich., 2077; Grand Haven Harbor, Mich., 2079; Grand River, Mich., 2081; Black Lake Harbor, Mich., 2083; Saugatuck Harbor, Mich., 2084; South Haven Harbor, Mich., 2085; Saint Joseph Harbor, Mich., 2086; New Buffalo Harbor, Mich., 2087; Michigan City Harbor, Ind., 2088.

EXAMINATIONS AND SURVEYS.—Plan and estimate of cost of a harbor of refuge at Ludington, Mich., 2090; Little Traverse Bay, Mich., near the village of Petoskey, with a view to constructing a harbor of refuge, 2095.

APPENDIX L L.

REPORT OF LIEUT. COL. O. M. POE, CORPS OF ENGINEERS, BVT. BRIG. GEN., U. S. A.

IMPROVEMENTS.—Hay Lake Channel, Saint Mary's River, Mich., 2098; Saint Mary's Falls Canal and River, Mich., 2104; operating and care of Saint Mary's Falls Canal, Mich., 2108; dry-dock at Saint Mary's Falls Canal, Mich., 2124; harbor at Cheboygan, Mich., 2128; harbor at Thunder Bay, Mich., 2129; harbor at Au Sable, Mich., 2130: Saginaw River, Mich., 2138; harbor of refuge, Sand Beach, Lake Huron, Mich., 2151; ice-harbor of refuge, Belle River, Mich., 2157; repairs of Saint Clair Flats Ship-Canal, Mich., 2159; operating and care of Saint Clair Flats Ship-Canal, Mich., 2160; Clinton River, Mich., Detroit River, Mich., 2165; information concerning Portage Lake and Lake Superior Ship-Canal, &c., 2170.

EXAMINATIONS AND SURVEYS.—Mackinac Harbor, Mich., 2180; Pine River, Saint Clair County, Mich., 2183; for harbor of refuge at or near Cross Village, Mich., 2185; old locks at the Saint Mary's Falls Canal for use as a dry-dock, 2186; Clinton River, Mich., 2190; Saint Clair River, Mich., to ascertain whether the erosion of the right bank is injuring the navigation of the river and Saint Clair Flats Canal, 2197.

APPENDIX M M.

REPORT OF MAJ. L. COOPER OVERMAN, CORPS OF ENGINEERS.

IMPROVEMENTS.—Monroe Harbor, Mich., 2209; Toledo Harbor, Ohio, 2211; Port Clinton Harbor, Ohio, 2215; Sandusky City Harbor, Ohio, 2216; Sandusky River, Ohio, 2218; Huron Harbor, Ohio, 2219; Vermillion Harbor, Ohio, 2222; Mouth of Black River, Ohio, 2223; Rocky River, Ohio, Cleveland Harbor, Ohio, 2227; Fairport Harbor, Ohio, 2235; Ashtabula Harbor, Ohio, 2240; Conneaut Harbor, Ohio, 2245; Dunkirk Harbor, N. Y., 2246.

EXAMINATION.—At Cleveland, Ohio, for opening and improving the channel known as the old "river bed" of the Cuyahoga River, 2249.

APPENDIX N N.

REPORT OF CAPT. EDWARD MAGUIRE, CORPS OF ENGINEERS.

IMPROVEMENTS.—Erie Harbor, Pa., 2253; Buffalo Harbor, N. Y., 2255; Niagara River, N. Y., Wilson Harbor, N. Y., 2268; Olcott Harbor, N. Y., 2269; Oak Orchard Harbor, N. Y., 2270; Charlotte Harbor, N. Y., 2271; Pultneyville Harbor, N. Y., 273; Great Sodus Harbor, N. Y., 2274; Little Sodus Harbor, N. Y., 2276; Oswego Harbor, N. Y., 2278; Sackett's Harbor, N. Y., 2282.

EXAMINATIONS AND SURVEYS.—Niagara River, N. Y., from Youngstown to Lake Ontario, Scajaquada [Scajacuada] Creek, at Buffalo, N. Y., 2283; Salmon River, N. Y., at and below Fort Covington, 2286; mouth of Salmon River, and the inner natural harbor thereat, on Lake Ontario, N. Y., with a view of making a harbor of refuge for vessels in distress and for purposes of commerce and navigation, 2291.

APPENDIX O O.

REPORT OF MAJ. MILTON B. ADAMS, CORPS OF ENGINEERS.

IMPROVEMENTS.—Ogdensburg Harbor, N. Y., 2293; Grass River at Massena, N. Y., 2296; breakwater at Rouse's Point, Lake Champlain, N. Y., 2297; Swanton Harbor, Vt., 2305; Plattsburg Harbor, N. Y., 2306; Burlington Harbor, Vt., 2307; Otter Creek, Vt., Ticonderoga River, N. Y., 2309.

EXAMINATIONS AND SURVEYS.—Whitehall Harbor, N. Y., 2310; Lake Champlain at Four Channels, N. Y., 2314; mouth of the Saranac River at Plattsburg, N. Y., 2318; Maquam Bay, Swanton, Vt., 2321.

APPENDIX P P.

REPORT OF LIEUT. COL. GEORGE H. MENDELL, CORPS OF ENGINEERS, BVT. COL., U. S. A.

IMPROVEMENTS.—Oakland Harbor, Cal., 2327; Wilmington Harbor, Cal., 2333; Redwood Harbor, Cal., 2338; Petaluma Creek, Cal., removal of sunken vessels or craft obstructing or endangering navigation, 2339.

EXAMINATIONS AND SURVEYS.—Islais Creek, San Francisco Bay, Cal., 2340; Mateo River, Cal., 2342; Napa River, Cal., 2343.

APPENDIX Q Q.

REPORT OF COL. C. SEAFORTH STEWART, CORPS OF ENGINEERS.

IMPROVEMENT.—Harbor at San Diego, Cal., 2349.

APPENDIX R R.

REPORT OF CAPT. A. H. PAYSON,, CORPS OF ENGINEERS.

IMPROVEMENTS.—Humboldt Bay and Harbor, Cal., 2351; San Joaquin River, Cal., 2353; Mokelumne River, Cal., 2358; Sacramento and Feather rivers, Cal., 2360; Colorado River, Nev., Cal., an l Ariz., 2365.
EXAMINATION.—Yuba River, Cal., 2373.

APPENDIX S S.

REPORT OF CAPT. CHARLES F. POWELL, CORPS OF ENGINEERS.

IMPROVEMENTS.—Columbia and Willamette rivers, below Portland, Oreg., 2376; mouth of the Columbia River, Oreg. and Wash., 2382; entrance to Coos Bay, Oreg., 2388; entrance to Yaquina Bay, Oreg., 2393; mouth of Coquille River, Oreg., 2398; Skagit, Steilaquamish, Nootsack, Snohomish and Snoqualmie rivers, Wash., 2403; Chehalis River, Wash., 2405; gauging waters of the Columbia River and principal tributaries, 2408.
EXAMINATIONS AND SURVEYS.—Bar at the mouth of the entrance to Nehalem Bay and River, Oreg., 2409; Olympia Harbor, Wash., 2413; Puyallup River, Wash., 2417; Willapah River, Wash., 2420.

APPENDIX T T.

REPORT OF MAJ. WILLIAM A. JONES, CORPS OF ENGINEERS.

IMPROVEMENTS.—Upper Willamette River, Oreg., 2424; Columbia River at the Cascades, Oreg., 2426; Upper Columbia and Snake rivers, Oreg. and Wash., 2437; Cowlitz River, Wash., Lower Clearwater River, Idaho, 2439.
EXAMINATIONS AND SURVEYS.—Snake River between Lewiston and mouth of Boisé River, Idaho, 2440; Cœur d'Alene Lake and River, Idaho, Saint Joseph's River, Idaho, 2442; Lewis River, Wash., 2444; Columbia River above mouth of Snake River, Wash., 2445; Upper Columbia and Snake rivers, 2452.

APPENDIX U U.

REPORT OF MAJ. G. J. LYDECKER, CORPS OF ENGINEERS.

IMPROVEMENTS.—Washington Aqueduct, 2453; increasing the water supply of the city of Washington, 2469; erection of fishways at the Great Falls of the Potomac River, 2499.

APPENDIX V V.

REPORT OF LIEUT. COL. JOHN M. WILSON, CORPS OF ENGINEERS, COLONEL, U. S. A.

IMPROVEMENT and care of public buildings and grounds in and around Washington, D. C., 2503.

APPENDIX Y Y.

REPORT OF LIEUT. COL. O. M. POE, CORPS OF ENGINEERS, BVT. BRIG. GEN., U. S. A.

Issue of Published Charts of the Northern and Northwestern Lakes..... 2519

EXPLORATIONS AND SURVEYS.

APPENDIX Z Z.

REPORT OF MAJ. W. R. LIVERMORE, CORPS OF ENGINEERS.

Explorations and Surveys in the Department of Texas 2521

APPENDIX A A A.

REPORT OF LIEUT. DAN C. KINGMAN, CORPS OF ENGINEERS.

Explorations and Surveys in the Department of the Platte 2525

APPENDIX B B B.

REPORT OF LIEUT. JOHN BIDDLE, CORPS OF ENGINEERS.

Explorations and Surveys in the Department of Dakota 2527

APPENDIX C C C.

REPORT OF LIEUT. THOMAS L. CASEY, CORPS OF ENGINEERS.

Explorations and Surveys in the Department of California 2529

APPENDIX D D D.

REPORT OF LIEUT. THEODORE A. BINGHAM, CORPS OF ENGINEERS.

Explorations and Surveys in the Department of Arizona 2531

PART IV.

APPENDIX W W.

REPORTS OF THE MISSISSIPPI RIVER COMMISSION.

Q. A. GILLMORE, Col. of Engineers, Bvt. Maj. Gen., U. S. A., *President.*
C. B. COMSTOCK, Lieut. Col. of Engineers, Bvt. Brig. Gen., U. S. A.,
CHARLES R. SUTER, Major of Engineers, U. S. A.,
Mr. HENRY MITCHELL, Coast and Geodetic Survey,
Mr. B. M. HARROD, Civil Engineer,
Mr. S. W. FERGUSON, Civil Engineer,
Mr. ROBERT S. TAYLOR,
Commissioners.

Letter of the Secretary of War, 2535; report of Commission for 1884, 2535; list of appendices accompanying the report, 2571; list of plates accompanying the report, 2572.
Report for 1885, 2859; list of appendices, 2875.

APPENDIX X X.

REPORTS OF THE MISSOURI RIVER COMMISSION.

CHARLES R. SUTER, Major of Engineers, U. S. A., *President.*
ALEX. MACKENZIE, Major of Engineers,
O. H. ERNST, Major of Engineers,
Mr. G. C. BROADHEAD,
Mr. WILLIAM J. BROATCH,
Commissioners.

Letter of the Secretary of War, 2989; report of Commission for 1884, 2989; report of Commission for 1885, 2999.

APPENDIX I.

IMPROVEMENT OF PATAPSCO RIVER AND CHANNELS TO BALTIMORE, MARYLAND.

REPORT OF LIEUTENANT-COLONEL WILLIAM P. CRAIGHILL, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1885, WITH OTHER DOCUMENTS RELATING TO THE WORK.

UNITED STATES ENGINEER OFFICE,
Baltimore, Md., July 27, 1885.

GENERAL: I have the honor to forward herewith the annual report for the year ending June 30, 1885, for the works of improvement of rivers and harbors which have been in my charge for the whole year.

In cases where the commercial statistics may not be as full and complete as desirable, it is not for want of effort on my part to have them so.

Besides the duties referred to above, I was in charge of certain other improvements until their transfer under proper authority, as indicated below.

To Maj. P. C. Hains, Corps of Engineers, the James River, Virginia, July 26, 1884, and the Shenandoah River, West Virginia, July 29, 1884.

To Capt. F. A. Hinman, Corps of Engineers, the Appomattox River, July 26, 1884.

To Mr. W. F. Smith, United States Agent, the Chester, Wicomico, Choptank, and Elk rivers, Corsica Creek, and Upper Thoroughfare at Deal's Island, Maryland; Broad Creek, Delaware; Annapolis Harbor, Maryland; inner harbor of Cambridge, Maryland; and Susquehanna River at and near Havre de Grace, Maryland, July 31, 1884.

To Capt. W. H. Bixby, Corps of Engineers, the Cape Fear River below Wilmington, N. C., January 15, 1885.

I have also been during the year supervising engineer of the districts in charge of Captains Bixby and Hinman, Corps of Engineers, and of Messrs. S. T. Abert and W. F. Smith, United States Agents, as well as of the district of Maj. W. H. Heuer, Corps of Engineers, from July 1, 1884, to January 20, 1885, when he was relieved at his station in Philadelphia, Pa., by Lieutenant-Colonel Robert, Corps of Engineers.

Very respectfully, your obedient servant,

W. P. CRAIGHILL,
Lieutenant-Colonel of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

IMPROVEMENT OF CHANNELS TO BALTIMORE, MARYLAND.

Operations during the year have been directed to increasing the width of the channels, with depth of 27 feet at mean low water, and have been confined to the Craighill and cut-off sections which form the two lower divisions of the improvement.

At the end of June, 1884, Mr. Thomas Potter had excavated and re-

moved from the cut-off 290,186 cubic yards, under his contract of April 9, 1883. He continued operations during 1884, and during December completed his contract, forming one cut 45 feet wide and about 4½ miles long, removing in so doing a total of 497,307 cubic yards.

Two hundred and fifty thousand dollars having been appropriated by act of July 5, 1884, for the continuance of this work, proposals were opened August 11, 1884, after due advertisement, and a contract entered into with the American Dredging Company to remove about 1,500,000 cubic yards, at 15 cents per yard, including the hard material in the cut-off.

Operations were commenced by them under this contract August 28, 1884, and continued until June 30, 1885, when the contract was completed. With the exception of a suspension on account of weather, from late in December, 1884, to April 1, 1885, they employed on this work from ten to twelve large clam-shell dredges and one large dipper-machine.

The result of their operations has been to add 150 feet to the 27-foot depth in Craighill Channel and 100 feet to the width of the cut-off.

They have excavated and removed during the year 1,508,126 cubic yards of material.

The available width of 27-feet-deep channels on June 30, 1885, were as follows:

	Feet.
Craighill Channel	350
Cut-off Channel	300
Brewerton Channel	250
Fort McHenry Channel	250

The total amount of material removed from the channels during the year ending June 30, 1885, was 1,715,247 cubic yards.

Owing to the failure of Congress at its last session to continue the appropriations for this improvement, the channels were early cleared of dredging-machines, and in April, 1885, a close and detailed survey of dredged channels was commenced. This work is now nearly completed, but the results are not in such shape as to permit their use in this report. A supplementary report will be made at an early date, if necessary, embodying these results, with detailed estimates for the completion of the original project for a channel 400 feet wide and 27 feet deep at mean low water.

An examination of the work as plotted shows quite considerable shoaling along the "*red* buoy" sides of the Craighill and Brewerton channels and at the angle between the Brewerton and Fort McHenry channels. This shoaling is in large part undoubtedly due to heavy-draught vessels striking against the bank and throwing large masses of material into the channels on their return to deep water. The sedimentary deposit amounts to very little.

The immediate supervision of this improvement has continued to be given by Mr. W. H. Hutton, with his usual zeal and ability.

Money statement.

July 1, 1884, amount available	$70,463	65
Amount appropriated by act approved July 5, 1884	250,000	00
	320,463	65
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	289,617	24
July 1, 1885, amount available	30,846	41
Amount (estimated) required for completion of existing project	200,000	00
Amount that can be profitably expended in fiscal year ending June 30, 1877	200,000	00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

Abstract of proposals for dredging in the channel leading to harbor at Baltimore, opened at 12.05 *p. m., August* 11, 1884.

No.	Name.	Address.	Quantity bid for.	Price per cubic yard.
				Cents.
1	Morris and Cumings Dredging Company	New York	All	16¾
			or Craighill Channel	14
2	N. Y. Steam Dredging Company	do	Brewerton	15
3	American Dredging Company	Philadelphia	100,000 yards in Craighill	13½
			All	15½
			100,000 yards in cut-off	25
4	D. Constantine	Baltimore	200,000 yards in Fort McHenry	12
5	George C. Fobes & Company	do	All of Craighill	12¾
			or Fort McHenry	17¼
			or 350, 000 from channel to channel in cut-off	23½
6	Thomas Potter	Jersey City	500, 000 yards in cut-off	19¼
7	Atlantic Dredging Company	Brooklyn, N. Y.	All	19½
8	National Dredging Company	Wilmington, Del.	Craighill	11 9/10
			Cut-off	20
			Brewerton	12 6/10
			Fort McHenry	19
			All	16½
9	Ross & Sanford	Jersey City	Craighill	11¾
			Cut-off	21 3/10
			Brewerton	13 9/10
			Fort McHenry	17 3/10
10	Edward Moore	Portland, Me.	Cut-off	23
			All	16½
11	Thomas P. Morgan	Washington	Fort McHenry	*16
			do	†26
12	Henry Du Bois' Sons	New York	Brewerton	10⅜
			100,000 from Craighill	‡10⅜
			100,000 from Fort McHenry	.....
			Channel next to Brewerton	10⅜
13	Benson & McNee	San Francisco	Craighill and Brewerton	23¼

* Material that can be worked with clam-shell dredge.
† For all hard material requiring dipper-dredge.
‡ Provided all bid for is awarded.

Contract made with American Dredging Company.

COMMERCIAL STATISTICS.

CUSTOM-HOUSE, COLLECTOR'S OFFICE,
Baltimore, Md., August 4, 1885.

SIR: Agreeably with your request of the 15th of May last you are herewith furnished with a summary of the commerce of the port of Baltimore for the fiscal year ending June 30, 1885:

Comparative value of importations for the years 1884 *and* 1885.

Imports.	1884.	1885.
Free	$5, 462, 886	$7, 019, 333
Dutiable	5, 960, 779	4, 833, 984
Total	11, 423, 665	11, 853, 317
Increase	.....	429, 652

Imports.	Sail.	Steam.
In American vessels (coin)	671	.....
In foreign vessels (coin)	2, 100	850
Total coin	2, 771	850
In American vessels (merchandise)	2, 758, 495	50, 771
In foreign vessels (merchandise)	809, 368	8, 231, 062
Total	3, 570, 634	8, 282, 683

RECAPITULATION.

Vessels.	Sail.	Steam.	Total.
Foreign	$811,468	$8,231,912	$9,043,380
American	2,759,166	50,771	2,809,937
Difference in favor of foreign vessels			6,233,443

DUTIES COLLECTED AND DUE ON MERCHANDISE IN BOND AND TRANSPORTATION IN BOND.

Duties collected	$2,001,155 86
Duties due on merchandise in bond	125,123 03
Duties due on merchandise transported in bond without appraisement	3,613 15
Duties on merchandise transported in bond without appraisement	184,870 58
Total	2,314,762 62
Currency, fees, &c	80,610 65
Total	2,395,373 27

COMPARISON AS BETWEEN 1884 AND 1885.

Total duties collected and due, 1884	$2,546,058 79
Total duties collected and due, 1885	2,314,762 62
Decrease	231,296 17

This showing is not unfavorable to the commercial trade of the port.
Tonnage collected, $22,591 14.

VALUE OF EXPORTS.

Exports, 1884	$43,064,217
Exports, 1885	45,041,634
Increase	1,977,417
Carried in American vessels:	
Steam	20,823
Sail	1,712,601
Total American	1,733,424
Carried in foreign vessels:	
Steam	40,879,225
Sail	2,428,985
Total foreign	43,308,210

The exhibit of the export trade during the year shows an increase in the general lines of merchandise. While wheat exports have fallen off, flour has been shipped in largely increased quantities in its place, while in meat products, provisions, &c., the trade has been active.

NAVIGATION.

Entrances and clearances.	Number.	Tonnage.
VESSELS ENTERED FROM FOREIGN PORTS.		
American:		
Sail	164	54,151
Steam	4	896
Foreign:		
Sail	127	78,876
Steam	351	498,648
Total	646	632,371
VESSELS CLEARED FOR FOREIGN PORTS.		
American:		
Sail	167	52,221
Steam	5	1,741
Foreign:		
Sail	104	68,302
Steam	409	608,200
Total	685	730,464
Vessels entering coastwise	1,541	934,746
Vessels clearing coastwise	1,747	1,131,521
Total	3,288	2,075,267

Emigrants arriving in 1884	38,507
Emigrants arriving in 1885	15,928
Decrease	22,579

REGISTERED TONNAGE.

Description.	Number of vessels.	Gross tonnage.	Net tonnage.
Permanent registers:			
Sail	60	18,980 80	18,041 78
Steam	1	376 72	223 69
Temporary registers:			
Sail	26	11,514 85	10,939 80
Permanent enrollments:			
Sail	617	29,652 56	28,169 86
Steam	60	19,219 87	14,436 37
Barges	9	2,207 58	2,207 58
Iron vessels, steam	48	31,149 90	22,608 71
Temporary enrollments:			
Sail	26	5,191 77	4,933 26
Steam	2	1,283 61	912 42
Licenses under 20 tons:			
Sail, coasting trade	365	4,371 23	4,152 63
Wooden, steam, coasting trade	57	1,193 80	623 56
Iron, steam, coasting trade	4	110 70	64 00
Total	1,275	125,253 39	107,313 66
Licences of enrolled vessels in the fisheries	4	118 45	112 53
Licenses of enrolled vessels in coasting trade	772	99,164 67	83,023 75
Licenses of enrolled yachts	4	187 21	129 16
Vessels built	6	790 51	741 35
Vessels lost	8	194 42	184 70
Vessels abandoned	4	229 93	226 85

SUMMARY OF VESSELS LICENSED.

Description.	Number of vessels.	Gross tonnage.	Net tonnage.
Permanent licensed:			
Sail vessels	593	28,742 63	27,305 41
Wooden steam	57	18,643 26	13,978 57
Iron steam	44	29,834 11	21,719 12
Barges	9	2,207 58	2,207 58
Temporary licensed:			
Sail	59	14,702 14	13,996 24
Wooden steam	9	4,290 25	3,227 13
Iron steam	1	931 91	718 86
Total	772	99,351 88	83,152 91

Hoping that this summary of the trade of the port may meet your official requirements,

I am, very respectfully, yours, &c.,

E. H. WEBSTER,
Collector of Customs.

Col. WM. P. CRAIGHILL,
U. S. Engineer Corps.

APPENDIX J.

IMPROVEMENT OF THE HARBORS AT WASHINGTON AND GEORGETOWN, DISTRICT OF COLUMBIA—IMPROVEMENT OF THE POTOMAC RIVER AT WASHINGTON, DISTRICT OF COLUMBIA—IMPROVEMENT OF JAMES RIVER, VIRGINIA, AND OF SHENANDOAH RIVER, WEST VIRGINIA.

REPORT OF MAJOR PETER C. HAINS, CORPS OF ENGINEERS, BVT. LIEUT. COL., U. S. A., OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1885, *WITH OTHER DOCUMENTS RELATING TO THE WORKS.*

IMPROVEMENTS.

1. Harbors at Washington and Georgetown, District of Columbia.
2. Potomac River at Washington, District of Columbia.
3. James River, Virginia.
4. Shenandoah River, West Virginia.

UNITED STATES ENGINEER OFFICE,
Washington, D. C., July 31, 1885.

SIR: I have the honor to transmit herewith my annual reports on the river and harbor improvements under my charge for the fiscal year ending June 30, 1885.

Very respectfully, your obedient servant,

PETER C. HAINS,
Major of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

IMPROVEMENT OF THE HARBORS OF WASHINGTON AND GEORGETOWN, DISTRICT OF COLUMBIA.

A history of the operations carried on with a view to the improvement of the harbors at Washington and Georgetown, D. C., was given in my annual report for the fiscal year ending June 30, 1883.

My last annual report gave an account of the work to be done under a contract entered into with the American Dredging Company, of Philadelphia, Pa., dated June 18, 1883, under which certain groups of rocks in the harbor at Georgetown, known as $A_{,,,}$ $D_{,}$ and $D_{,,}$ B and $B_{,}$ and F and $F_{,}$, were to be removed to a depth of 20 feet at mean low tide.

The work under the contract was prosecuted until December 20, 1884, when operations were brought to a stand-still by the inclemency of the weather. From that date until March 24, 1885, nothing was accomplished, as the continued presence of ice in the river, with swift currents, caused a total suspension of work. At the latter date work was again resumed, but temporarily delayed by the sickness of the diver, so that it was not until May 19, 1885, that the work was completed and the contract closed.

On September 30, 1884, proposals were invited by public advertisement for the removal of other rocks in the harbor that obstructed navigation. These rocks were designated by the following letters: L, N, M, K, O, and F, all of which were to be removed to a depth of 20 feet below mean low tide, and the C group, connected with the Georgetown shore, between the "waste weir" and the foot of "High" street, several of the outer projecting parts of which were to be removed to 16 feet below the same level. These rocks (the C group) lie so close to the shore that it was not thought necessary to remove them to the full depth of 20 feet. Besides, the cost of doing so would have been very great. In the future, they may be removed to a greater depth should commerce require it, or the wharves may be extended so as to reach deep water in the harbor. Bids for this work were opened October 22, 1884, and found to be as stated in the following abstract:

Abstract of proposals opened by Maj. Peter C. Hains, Corps of Engineers, at Washington, D. C., on October 22, 1884, for the removal of rocks in Georgetown Harbor, District of Columbia.

No.	Names and addresses of bidders.	Price for removal of group.							Total amount.
		L.	N.	M.	K.	O.	F.	C.	
1	William E. Chapman, Brooklyn, N. Y.....	$385	$1,150	$837 00	$1,400	$423 50	$3,702 60	$2,025 00	$9,923 10
2	American Dredging Co., Philadelphia, Pa.....	300	1,400	1,100 00	1,600	400 00	5,100 00	2,400 00	12,300 00
3	Solon S. Andrews, Biddeford, Me.....	270	1,242	837 00	1,512	297 00	5,049 00	2,187 00	11,394 00
4	Edward R. Lowe, New York, N. Y	175	805	542 50	980	195 00	3,272 00	1,417 50	7,387 00

The bid of Mr. Edward R. Lowe, of New York, was accepted, it being the lowest and most advantageous to the Government, and a contract was entered into with him on November 5, 1884. Owing to the lateness of the season Mr. Lowe did not commence work until April 29, 1885, and up to this time has removed the rocks L, M, and N. The method of doing the work is practically the same as that employed by the American Dredging Company, and as a full account of that was given in my last annual report it is not deemed necessary to refer to it here.

The removal of the K and O rocks is nearly completed, when the plant will be put to work on the F group and the removal of the C group will follow.

With the removal of these rocks the harbor at Georgetown will be navigable for the largest class of vessels that can reach that port, and as the funds on hand are sufficient for attaining that object no further appropriation is asked.

On June 30, 1884, there was available the sum of $4,418.70, which by the terms of the appropriation act was limited to the Washington channel. Under that appropriation 35,116 cubic yards of material were

dredged during the month of March, 1885, from that channel, but as operations in that locality are more closely connected with the improvement of the Potomac River in the vicinity of Washington, D. C., reference is requested to the report on that work for detailed information.

The amounts appropriated for this work are as follows:

June 11, 1870	$50,000
March 3, 1873	50,00
June 18, 1878	50,00
March 3, 1879	50,00
June 14, 1880	40,00
March 3, 1881	50,00

The work is in the collection district of Georgetown, D. C., which is the nearest port of entry. Nearest light-house, Jones Point, Virginia. Revenue collected for the year ending June 30, 1885, $22,126.90.

Money statement.

July 1, 1884, amount available		$34,084 78
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$15,072 48	
July 1, 1885, outstanding liabilities	586 63	
		15,659 11
July 1, 1885, amount available		18,425 67

Abstract of contracts for improving harbors at Washington and Georgetown, D. C., in force during fiscal year ending June 30, 1885.

No.	Contractors and addresses.	Date of contract.	Subject of contract.	Amount.
1	American Dredging Company, Philadelphia, Pa.*	June 18, 1883	Removal of rocks	$14,400
2	Edward R. Lowe, New York, N. Y.	November 5, 1884	do	7,387

* Completed.

Value of receipts and shipments at the harbors of Washington and Georgetown, D. C., during the year 1884.

Articles.	Value.	Articles.	Value.
Asphalt	$194,520 00	Oil, crude	$4,500 00
Beef cattle, calves, and sheep	54,850 00	Oysters	118,920 50
Cement (part foreign)	51,692 00	Paving-blocks	10,248 00
Coal, anthracite	889,314 00	Potatoes (sweet)	6,993 00
Coal, bituminous	715,790 00	Salt	7,085 00
Fertilizers	297,000 00	Sand	11,291 00
Fish	141,550 00	Stone, dressed and rough	60,792 00
Flour (shipped)	807,500 00	Water and gas pipe	269,280 00
Grain (wheat and corn)	67,640 00	Watermelons	22,424 10
Hay and straw	63,000 00	Wood, oak and pine	80,092 00
Ice	552,500 00		
Lumber (board measure)	487,204 00	Total	4,975,385 60
Lumber, laths, shingles, and cedar posts	61,200 00		

The following table shows the amount of miscellaneous freight (value not known) brought to these harbors, and not included in the foregoing:

By steamer from—

	Tons.
New York	58,250
Philadelphia	24,062
Baltimore	4,235
Norfolk	102,187
By river steamers	44,100
	232,834

Ferry and local passenger steamers not included.

NUMBER OF VESSELS OF VARIOUS CLASSES ARRIVING AND DEPARTING DURING THE YEAR 1884.

Steamers drawing from 5 to 15 feet	1,050
Vessels drawing from 10 to 15 feet	687
Vessels drawing from 8 to 10 feet	56
Vessels drawing from 4 to 8 feet	1,093
Barges	344

Ferry and local passenger steamers not included.

J 2.

IMPROVEMENT OF THE POTOMAC RIVER AT WASHINGTON, DISTRICT OF COLUMBIA.

A history of the changes that have taken place in the topography of the Potomac River in the vicinity of the national capital, of the various surveys made and plans proposed for improving the river and city front during the last half century, is contained in my annual report for 1883.

The first appropriation for the work was made by act of Congress passed August 2, 1882. This act reads as follows:

> Improving the Potomac River in the vicinity of Washington with reference to the improvement of navigation, the establishment of harbor lines, and the raising of the flats under the direction of the Secretary of War, and in accordance with the plan and report made in compliance with the river and harbor act approved March 3, 1881, and the reports of the Board of Engineers made in compliance with the resolution of the Senate of December 13, 1881, four hundred thousand dollars.
>
> And it is hereby made the duty of the Attorney-General to examine all claims of the title to the premises to be improved under this appropriation; and see that the rights of the Government in all respects are secured and protected, and if he deems it necessary he is authorized to cause a suit or suits in law or in equity to be instituted in the name of the United States, in the supreme court of the District of Columbia, against any and all claimants of title under any patent which in his opinion was by mistake or was improperly or illegally issued for any part of the marshes or flats within the limits of the proposed improvement.

By act approved July 5, 1884, Congress made an additional appropriation of $500,000 for continuing the improvement. The object of the improvement is clearly stated in the act making the first appropriation. The method of carrying it into effect is to dredge material from the river by means of dredging machines and deposit it on the flats, thereby improving navigation and raising the marshes above overflow at the same time. The Washington and Virginia channels of the river are to be made deep enough and wide enough to accommodate the largest class of vessels that can reach Giesboro' Point; the latter channel to have such cross-sectional area that it can discharge the highest freshets without overflowing its banks—at least on the side toward the city. The flats are to be raised until the portion above Long Bridge is 3 feet above the freshet slope of 1877, and the part below the bridge has the same height at the middle line, from which line it will slope toward each channel to the margin of the fill, where it will be 6 feet above mean low tide. A large tidal reservoir, not less than 8 feet deep, will be established between Long Bridge and the sewer canal, to supply fresh water to the Washington Channel, which channel, at the upper end, will be cut off from communication with the Virginia Channel. A smaller

reservoir is to be established near the foot of Seventeenth street, for the purpose of flushing the sewer canal. The large reservoir is to be provided with inlet and outlet gates of ample dimensions to fill it on the flood tide from the Virginia Channel, and empty it on the ebb tide into the Washington channel. The plan contemplates the removal or rebuilding of Long Bridge on fewer piers, with wider spans; and also that the sewage now discharged into the Washington Channel be intercepted and conveyed to James Creek.

The condition of the river front at the time the first appropriation was made had become so bad, in a sanitary point of view, that certain parts of the city had become almost uninhabitable. This was caused by deposits on the city front of sediment from the river and the solid matter from the sewers, which had formed flats or marshes covering an area of several hundred acres. These flats, on which there was a dense growth of marsh-grass and reeds, were covered by water for about one-half the time and uncovered the other half. In the latter condition they were exposed for a time each day to the rays of the sun, which in summer produced favorable conditions for malarial diseases. The Washington and Georgetown channels had not the depth and width that navigation required, and dredging was frequently necessary for the relief of commerce. The depth of water on the bar below Long Bridge was only 16 feet, while on the bar above the bridge it was only 15 feet at mean low tide. A narrow channel through each was kept open by repeated dredging, as they invariably shoaled up after a freshet.

At the date of my last annual report there had been dredged from the river 1,136,531 cubic yards of material, and a channel from deep water near Giesboro' Point to Georgetown 20 feet deep at low tide and about 300 feet wide had been obtained. The spoils taken from the river bed were deposited on the marshes in front of the city, raising an area of about one hundred and twenty acres above overflow by ordinary high tides. About six acres near the Naval Observatory had been filled to 6 feet above low tide, and about 5,100 linear feet of embankment along the margin of Sections I and II had been built.

During the past fiscal year operations have been continued as follows: The dredging operations in the Virginia Channel were continued under the contract with P. Sanford Ross until October 6, 1884, when his contract was closed. The total amount dredged and deposited on the flats under this contract was 1,418,771.42 cubic yards. The price paid was 21.2 cents per cubic yard, measured in scows. The plan of doing the work was to dredge the material into scows, tow the latter to a dumping basin, and drop the material into it. It was then redredged and loaded into cars, which were taken to the place of final deposit on the flats. This plan necessitated double handling, required the construction of long lines of trestle-work, which afterward became useless, and about doubled the work performed, but it helped in another way, by softening the material, so that when it was dropped from the car it spread out latterly to a great distance.

On July 21, 1884, bids were solicited by advertisement for dredging about 1,000,000 cubic yards along the front of the city in the Washington Channel, which reaches from the junction of the Eastern Branch with the Potomac to Long Bridge, the material taken out of the river to be deposited on the neighboring flats—Section III. The manner of doing the work was left to the option of the contractor, but he was required to explain in his bid the method he proposed to adopt and to satisfy the engineer that it was adapted to the work.

The following is a list of the bids received:

Abstract of proposals opened by Maj. Peter C. Hains, Corps of Engineers, at Washington, D. C., August 20, 1884, *for dredging in the Washington Channel of the Potomac River, and depositing the material on Section III, Potomac Flats, at Washington, D. C. Estimated amount,* 1,000,000 *cubic yards.*

No.	Names and addresses of bidders.	*Measurement.	Cubic yards.	Price per cubic yard.	Amount.
				Cents.	
1	D. E. Culver Company, New York City, N. Y...	Scow	1,125,000	18½	$208,125 00
2	Rittenhouse Moore, Mobile, Ala.....	Scow	1,125,000	13¾	154,687 50
3	Benson & McNee, San Francisco, Cal.....	In place ..	1,000,000	12.37	123,700 00
4	Morris & Cumings Dredging Company, New York City, N. Y.	Scow	1,125,000	28	315,000 00
5	Ross & Sanford, Jersey City, N. J.....	½ scow....	562,500	19¾	209,843 75
		½ in place .	500,000	19¾	
6	National Dredging Company, Wilmington, Del.	Scow	1,125,000	21	236,250 00

*1,000,000 cubic yards in place calculated as equivalent to 1,125,000 cubic yards in scow.

The bid of Messrs. Benson & McNee, of San Francisco, Cal., was the lowest, and it was accepted.

Their plan for doing the work was to suck the material up from the bed of the river by means of a large centrifugal pump and discharge it on the flats, at the desired place, through pipes. The vehicle for conveying the solid matter is water, and the dredge built on this principle is called *hydraulic.* The work was to have been commenced by December 1, 1884; the contractors, however, met with some delay in getting their machinery constructed, and it was not until December 24 that the dredge, No. 1, actually began work. It was found, after she got to work, that she was weak in certain parts; these gave way from time to time under the strain to which they were put, and much time was lost in repairing breaks. All, or nearly all, the weak parts have since been replaced by stronger ones, and the machine, in consequence, is in much better condition for work and is making better progress. It is evident, however, that the engines are deficient in power, and it may be necessary to replace them by new ones, or put in a smaller pump, when the discharge-pipe is lengthened. Considerable delay was also caused by the inexperience of the hands employed, few of whom had ever seen a machine of this kind. Cold weather also caused considerable delay; during a part of the winter the river was frozen over so that work was impracticable. The machine consists of a large rotary pump, mounted on a scow-built vessel 100 feet long and 50 feet beam. From the pump there is a cast-iron suction pipe leading to the forward part of the vessel and thence to the water. The vertical part of this pipe is rigidly suspended from a frame which rotates from one side to the other across the bow of the vessel and allows the lower end of the pipe to describe the arc of a circle 60 feet in diameter. In this way the machine makes a cut 60 feet wide at each forward movement. The suction-pipe is telescopic, so that it can be lengthened or shortened as the depth to be made requires. Connected with the pump is a discharge-pipe, which passes over the side of the vessel and is made flexible by joints of rubber cylinders or cast-iron ball-joints. The discharge-pipe is carried to land on pontons or flat-boats, and from thence to the place of discharge on the ground. The machine is provided with two spuds to hold her steadily in position, and is moved forward or backward by means of lines. The lower end of the suction-pipe is provided with a cast-iron hood or bonnet, 8 feet in diameter. The material forming the bed of

the river is cut up and agitated at the mouth of the suction-pipe by a system of knives or plows which rotate about a vertical shaft passing through the center of the hood; it thus becomes mixed with the water, and is taken into the suction-pipe by the vacuum created in the pump, after passing through which it enters and is discharged through the discharge-pipe. The proportion of solid matter to water that is pumped through the pipes varies with the character of the material, the height it has to be raised, the length of the discharge-pipe, and the velocity at which the pump is running at the time. Judged from specimens taken at the end of the discharge-pipe, the proportion of solid matter to water, under favorable circumstances, is as great as 25 to 35 per cent.; much of the time, however, it does not reach 10 per cent. The machine does good work when an average of 10 per cent. of solid material can be kept up continuously. As to the character of the material that can be dredged by this sort of machine, no better evidence that the occular demonstration that can be made at the end of the discharge-pipe is needed. There one will find all sorts of material that has come from the river bed, silt, balls of clay, sand, gravel, and bowlders from the size of an egg to that of a man's head.

The material is discharged in low conical heaps. The lightest is carried off to to a distance; the heaviest dropped near its exit from the pipe. Stiff clay is cut up at the mouth of the suction-pipe and discharged in the form of balls, a form given to it in its passage through the pipes. This mode of dredging requires the use of embankments inclosing the space to be filled, and some means of drawing off the water when the solid matter has settled. It has advantages over any other known method in that it requires but little or no labor to spread the material out to any required grade, and it makes a smooth and even bottom, so that the amount of dredging to get a certain depth of water can be estimated with more exactness. On this work the discharge-pipe has not yet exceeded in length about 1,800 feet. Up to that distance the machine works well in soft material, and has done fairly well in hard material. It is thought that the machines now on the work have not power enough to drive the material through the pipes where the distance exceeds 2,000 feet. A third machine is being built, with more power and some improvements in other respects. This latter machine will be used when the discharge-pipe is too long for the other two.

The material is taken from the river at depths varying from 2 to 20 feet below the surface; that from the latter depth must, therefore, be lifted through a vertical height of about 28 feet to reach the point of discharge. The total height to which the material was lifted by the other process was about 70 feet.

The following is the monthly statement of the amount of work done by each one of the two hydraulic dredges engaged on this improvement. The amount is estimated in the cut.

Period.	Dredge No. 1.	Approximate length of discharge-pipe.	Dredge No. 2.	Approximate length of discharge-pipe.
	Cub. yds.	*Feet.*	*Cub. yds.*	*Feet.*
To March 31, inclusive	24, 534	600	10, 582	600
April	38, 688	900	58, 033	900
May	46, 764	650	89, 602	1, 050
June	68, 315	900	90, 279. 9	1, 200

With a view to filling in the area between the Monument grounds and the margin of the proposed tidal reservoir, as well as the marshes in close proximity to the sewer canal, as soon as practicable, bids were solicited by advertisement for forming an embankment along the northeast and northwest margins of the tidal reservoir. This embankment will become the margin itself when the space behind it is filled in.

In response to the advertisement, the following bids were received:

Abstract of proposals opened by Maj. Peter C. Hains, Corps of Engineers, at Washington, D. C., August 4, 1884, for dredging and forming embankment along the northwest and northeast margins of the tidal reservoir, Section II, Potomac Flats, Washington, D. C.

No.	Names and addresses of bidders.	Estimated number of cubic yards.	Price per cubic yard.	Amount.
			Cents.	
1	The D. E. Culver Company, New York City, N. Y	120,000	11½	$13,800
2	American Dredging Company, Philadelphia, Pa	120,000	16	19,200
3	Daniel Constantine, Baltimore, Md	120,000	19	22,800
4	Thomas P. Morgan, Washington, D. C	120,000	22½	27,000
5	Ross & Sanford, Jersey City, N. J	120,000	13 9/10	16,680
6	Atlantic Dredging Company, Brooklyn, N. Y	120,000	13½	16,200
7	Morris & Cumings Dredging Company, New York City, N. Y	120,000	15	18,000

The bid of the D. E. Culver Company, of New York, the lowest, was accepted.

The estimated amount of dredging to form the embankment was 120,000 cubic yards, and this amount represents so much fill on the flats. The trench from which the material was taken is a little over 100 feet wide and not less than 6 feet deep. It was formed by making successive cuts, depositing the material as far from the side of the dredge as possible, and allowing it to harden. After the first cut was made, riprap stone was deposited along the shore side of the trench to a height of 3 feet above low tide. This stone forms a footing for the embankment, protecting it from sliding or pressing out, and gives a foundation for a slope paving, which will be needed at a later period of the work.

The work was promptly begun August 11, 1884, but owing to bad weather, a machine with too short a boom, and a badly constructed chute, the work was not completed until June 18, 1885, when the contract was closed. The amount excavated and deposited in embankment was 121,413 cubic yards.

On August 1, 1884, proposals were solicited for dredging and embankment along the Washington Channel side of the proposed fill below Long Bridge.

The following is an abstract of the bids received:

Abstract of proposals opened by Maj. Peter C. Hains, Corps of Engineers, at Washington, D. C., August 20, 1884, for dredging and forming embankment along the northeast margin of Section III, Potomac Flats, at Washington, D. C.

No.	Names and addresses of bidders.	Estimated number of cubic yards.	Price per cubic yard.	Amount.
			Cents.	
1	Morris & Cumings Dredging Company, New York City, N. Y	150,000	22	$33,000 00
2	Atlantic Dredging Company, Brooklyn, N. Y	150,000	13½	20,250 00
3	Ross & Sanford, Jersey City, N. J	150,000	11	16,500 00
4	Daniel Constantine, Baltimore, Md	150,000	12 3/10	18,450 00
5	Thomas P. Morgan, Washington, D. C	150,000	15 4/10	23,100 00
6	Frank C. Somers, Philadelphia, Pa	150,000	10⅝	15,937 50

The contract was awarded to Frank C. Somers, of Philadelphia, by whom it was carried out, after some delay due to cold weather and other causes.

This contract was practically completed on June 30, 1885, only a wreck and a few lumps remaining to be removed. The embankment is similar in all respects to that just described, and forms the margin of the fill below Long Bridge on the Washington Channel side. The amount of dredging and embankment done under this contract was 162,309 cubic yards. The stone that forms the footing of this embankment, as well as that along the tidal reservoir, was furnished by the Potomac Red Sandstone Company at 81 cents per cubic yard, delivered in place. It is the ordinary rough quarry stone, varying in weight from 15 to 250 pounds. It was furnished under contract made in accordance with bids received in response to a public advertisement dated August 2, 1884.

The following is an abstract of the bids received:

Abstract of proposals opened by Maj. Peter C. Hains, Corps of Engineers, at Washington, D. C., August 20, 1884, for furnishing riprap stone for the work of improving Potomac River.

No.	Names and addresses of bidders.	Margin of tidal reservoir.			Section III.			Total amount.
		Cubic yards.	Price per cubic yard.	Amount.	Cubic yards.	Price per cubic yard.	Amount.	
1	Simon Carmody, New Geneva, Pa ..	15,000	$2 30	$34,500	15,000	$2 30	$34,500	$69,000
2	G. Vanderwerken, Georgetown, D. C..	15,000	97	14,550	15,000	1 14	17,100	31,650
3	J. A. Blundon, Georgetown, D. C	15 000	1 05	15,750	15,000	1 25	18,750	34,500
4	W. H. Groat & Co., Washington, D. C.	15,000	97	14,550	15,000	97	14,550	29,100
5	Potomac Red Sandstone Company, Washington, D. C	15,000	69	10,350	15,000	94	14,100	*24,450
6	H. P. Gilbert, Georgetown, D. C.....	15,000	95	14,250	15,000	1 15	17,250	31,500

*Or 81 cents per cubic yard for whole amount, $24,300.

On August 30, 1884, proposals were invited for an additional 1,000,000 cubic yards of dredging in the Virginia Channel above Long Bridge, with a view to widening this channel and providing additional material for filling the flats above the bridge.

The following is an abstract of the bids received:

Abstract of proposals opened by Maj. Peter C. Hains, Corps of Engineers, at Washington, D. C., on September 17, 1884, for dredging in the Virginia Channel of the Potomac River, and depositing the material on the Potomac Flats at Washington, D. C. Estimated amount, 1,000,000 cubic yards.

No.	Names and addresses of biddes.	Measurement.*	Cubic yards.	Price per cubic yard.	Amount.
				Cents.	
1	Benson & McNee, San Francisco, Cal.....	In place...	1,000,000	15.45	$154,500 00
2	National Dredging Company, Wilmington, Del.	Scow.....	1,125,000	21	236,250 00
3	Moore & Wright, Portland, Me	....do.....	1,125,000	24	270,000 00
4	Morris & Cumings Dredging Company, New York City, N. Y.	....do.....	1,125,000	25	281,250 00
5	Ross & Sanford, Jersey City, N. J	½ scow	562,500	16.3	173,187 50
		½ in place	500,000	16.3	
6	American Dredging Company, Philadelphia, Pa..	(†)	.....	21	.....

*1,000,000 cubic yards in place calculated as equivalent to 1,125,000 cubic yards in scow.
†No method of work or measurement stated.

The contract was awarded to Benson & McNee, of California, the same parties to whom the contract for dredging the Washington Channel was awarded. The method of doing the work is the same as that on their other contract, viz, by the use of an hydraulic dredge and discharge-pipe reaching from the dredging-ground to the place of deposit. After the award of this contract, the contractors built another dredge, designated as No. 2, to which reference has been already made. The commencement of the work was delayed by the severe winter weather and by the same defects in machinery as had been found in the first dredge. With a view of getting both machines into working condition, they were allowed to work in the Washington Channel, where they would be less exposed than in the Virginia Channel. In fact, it is not safe for any kind of dredge to work in the Virginia Channel in winter. During the month of April both machines worked in the Washington Channel, and on May 1, No. 1 was taken from that work and placed on the Virginia Channel. Her record has not yet come up to the expectations of her owners, but it must be acknowledged that she has found much harder digging than was anticipated. She has worked a great part of the time in compact beds of gravel and bowlders—material that tests the capacity of the machine to the utmost. The measurement of the material is in place, which represents an amount of material removed much in excess of scow measurement; the difference, it is believed, being as much as 25 per cent. in favor of the former. The machine is now in good working order, and it is expected that her record will very much improve as she progresses down-stream where the material is softer.

It was intended to have commenced the construction of the inlet gates of the tidal reservoir with funds appropriated by the act of July 5, 1884, but, after a careful consideration of the matter, it was decided that the construction of them could better be deferred until a new appropriation be made, and that the funds allotted to the inlet gates, with other funds that became available owing to the low price at which contracts for other work had been made, could be applied, with better advantage to the Government, in additional dredging. Accordingly, on January 26, 1885, I addressed you the following letter:

UNITED STATES ENGINEER OFFICE,
Washington, D. C., January 26, 1885.

SIR: Referring to my letter of July 17, 1884, submitting a project for the expenditure of the appropriation made by act of Congress approved July 5, 1884, for improving Potomac River at Washington, D. C., I desire to say that on a more careful study of the subject I am of the opinion that it would be to the interest of the Government to apply the $45,000 allotted to the inlet sluice-gates of the tidal reservoir, to dredging in the Virginia Channel below Long Bridge. It is not expedient to commence the construction of the sluice-gates until a sufficiently large appropriation is available for their completion, and, under any circumstances, it is not now advisable to construct them until after another appropriation is made.

The cross-sectional area of the Virginia Channel below Long Bridge is somewhat less than at the site of the bridge itself. With a view to lessening the danger of damage to the city by freshets and provide a more commodious channel below the bridge, one of a width more nearly equal to that which will be found above it when the present contract of Benson & McNee is carried out, I recommend that the allotment of $45,000 to the construction of sluice-gates be changed, so as to be for dredging the Virginia Channel below Long Bridge, the dredged material to be deposited on Section III of the flats. I also find I have sufficient funds on hand of the present appropriation to construct that portion of the embankment along the outer edge of the fill on Section II between Long Bridge and the site of the inlet gates, and the embankment along the southwest margin of the tidal reservoir. It is important that both of these embankments should be constructed with the least delay, in order to allow them to become hard and compact.

I therefore request that I be authorized to commence this work. The embankments

will be constructed in the same manner as that now being built along the Washington Channel—a trench will be made by means of a dredge with a long boom, and a footing of riprap formed in the trench to sustain the embankment that will be formed behind it.

All the work referred to above is in accordance with the approved project, and it is proposed to do it by contract, after advertisement in the usual way.

Very respectfully, your obedient servant,

PETER C. HAINS,
Major of Engineers.

To the CHIEF OF ENGINEERS, U. S. A.

The suggestion therein made having been approved by the Chief of Engineers, advertisements were issued on February 2, 1885, for dredging and embankment along the southeast margin of the tidal reservoir and the face of the fill between the site of the inlet gates and the southwest end of the causeway of Long Bridge, for stone to form the footing of the embankment, and for dredging in the Virginia Channel below Long Bridge, and in the tidal reservoir itself.

The following is an abstract of the bids received for dredging and embankment:

Abstract of proposals, opened by Maj. Peter C. Hains, Corps of Engineers, at Washington, D. C., March 2, 1885, for dredging and forming embankment along a part of the southeast margin of the tidal reservoir, and along the outer margin of flats on Section II, Potomac Flats, at Washington, D. C.

No.	Names and addresses of bidders.	Estimated number of cubic yards.	Price per cubic yard.	Amount.
			Cents.	
1	Ross & Sanford, Jersey City, N. J	87,000	16	$13,920
2	American Dredging Company, Philadelphia, Pa	87,000	17	14,790
3	Frank C. Somers, Philadelphia, Pa	87,000	16½	14,355

The lowest of these bids was considered high, and, with your approval, they were all rejected, as it was believed that the work could be done more economically and advantageously by day's labor, hiring such dredges as would be suitable for the work by the day. This plan was adopted. The embankment is formed in the same way as that below the bridge. To do it well and promptly requires the use of a light-draught dredge with a very long boom. Such a one was hired at a cost of $7.50 per working hour; the owner furnishing crew and paying all running expenses. She has, up to the present time, laid up in embankment 34,731 cubic yards, at a cost to the United States of 9½ cents per cubic yard.

The following is an abstract of the bids received for riprap stone:

Abstract of proposals opened by Maj. Peter C. Hains, Corps of Engineers, at Washington, D. C., March 2, 1885, for riprap stone.

No.	Names and addresses of bidders.	Estimated number of cubic yards.	Price per cubic yard.	Amount.
			Cents.	
1	G. Vanderwerken, Georgetown, D. C	11,000	85	9,350
2	H. P. Gilbert, Georgetown, D. C	11,000	94	10,340

The bid of Gilbert Vanderwerken being the lowest and most advantageous to the Government, the contract was awarded to him. Up to June 30, 1885, he has delivered 9,478.7 cubic yards.

The abstract of proposals for dredging in the tidal reservoir and Virginia Channel, below Long Bridge, and depositing the material on the flats, is as follows:

Abstract of proposals opened by Maj. Peter C. Hains, Corps of Engineers, at Washington, D. C., on March 2, 1885, for dredging in the tidal reservoir, Section II, Potomac Flats, and in the Virginia Channel, Potomac River, below Long Bridge, at Washington, D. C.

No.	Names and addresses of bidders.	Tidal reservoir.			Virginia Channel.			Total Amount.
		Estimated cubic yards.	Price per cubic yard.	Amount.	Estimated cubic yards.	Price per cubic yard.	Amount.	
			Cents.			*Cents.*		
1	Benson and McNee, San Francisco, Cal.	200, 000	15	$30, 000	500, 000	15	$75, 000	$105, 000
2	Morris and Cumings Dredging Company, New York City, N. Y.	200, 000	25½	51, 000	500, 000	25½	127, 500	178, 500
3	Atlantic Dredging Company, Brooklyn, N. Y.	200, 000	23½	47, 000	500 000	23½	117, 000	164, 000
4	American Dredging Company, Philadelphia, Pa.	200, 000	25	50, 000	500 000	25	125, 000	175, 000
5	Ross and Sanford, Jersey City, N. J.	200, 000	20	40, 000	500, 000	18½	92, 500	132, 500

As the bid of Benson and McNee was again the lowest and most advantageous to the Government, the contract was awarded them.

A third hydraulic dredge will be needed to do this work, and it is now being built. The time for beginning work is about the middle of August.

On August 25, 1884, I addressed a communication to the Chief of Engineers suggesting for the consideration of the Board of Engineers two slight modifications in the details of the plan of this improvement. The plan as recommended by the Board of Engineers in their preliminary report dated February 18, 1882, which plan was adopted by Congress, provided for substantially, and in its essential features, the harbor and shore lines of Mr. Abert's plan from Easby's Point to the Arsenal, and the low-grade filling and surrounding embankment of that place below Long Bridge * * * with Major Twining's high-grade filling and sluicing ponds between Long Bridge and Easby's Point; that is, the area below Long Bridge was to be filled to a uniform grade of 6 feet above mean low tide, and surrounded by an embankment 50 feet wide on top, with side slopes of 3 base to 2 vertical. The height of the embankment to be 3 feet above the freshet slope of 1877, making the average height of embankment about 12 feet above mean low tide and 6 feet above the level of the inclosed area. The distance between the crests of the embankments on the Washington Channel and that on the Virginia Channel side would be about 1,800 feet, and the area inclosed about 245 acres.

There are some obvious objections to the building of an embankment 6 feet high around such an area. If the land should be used as a park, such an embankment would shut out all view of the river except from the crest of the embankment itself; and whether used as a park or for any other purpose, the embankment would be still objectionable; for if the tide should rise 3 feet above the ordinary high-water line, rain water falling inside could not get out and would lie on the surface until it evaporated, or the level in the river should fall. A rise of 3 feet above

ordinary high-water line may be produced by a strong southeast wind and a spring tide, or it may occur during a rain storm. To obviate, in some degree, the objectionable features of a surrounding embankment, I suggested for the consideration of the Board of Engineers the propriety of raising the surface along the axis of the fill to the level of 3 feet above the freshet line of 1877, and sloping it towards Washington Channel and the Virginia Channel on an average grade of seven-tenths of a foot to 100 feet. This would bring the foot of the slope to the height of 6 feet above low-water line at the margin of the filled area. It would give good surface drainage; would obviate the necessity of drain-pipes and flap-valves through the embankment; would prevent the waters of the Virginia Channel from flowing across into the Washington Channel in times of freshet; and, if the reclaimed area should be made into a park, it would have no high embankment along the water's edge to obstruct the view and keep out the cooling breezes of summer. It is true, a part of it will be subject to overflow in times of high freshets, but as these occur but rarely, and last only a short time, it is thought no great damage would be done. A freshet of 6 or 7 feet, which is of more frequent occurrence, would do less damage under the modified plan than it might do under the other plan. The estimated cost of carrying this modification into effect, is only about $36,000 based on 18 cents per cubic yard for dredging and filling, but as this work is now done at a much lower figure than formerly, the actual cost of the entire improvement, it is believed, will not be be increased. This modification in the original project was adopted by the Board of Engineers.

The proposition to form a small tidal reservoir near the foot of Seventeenth street, for the purpose of flushing the sewer canal, was also adopted. This will add nothing to the cost of the improvement. This reservoir will be provided with inlet and outlet gates. The water will be taken into it from the large reservoir during the rise of the tide, and discharged into the sewer canal during the ebb tide. In this way about 10,000,000 gallons of water may be emptied into the canal on each ebb tide. This reservoir will have an area of about 8 acres. The construction of the embankment along the margin was made during the winter and early spring. The soil covering this area consists largely of the material brought down the large sewer that discharges at the foot of Seventeenth street, and it was not thought desirable to turn it up during warm weather. Moreover, it was for the most part so soft that it was necessary to put in some kind of temporary retaining wall to hold the material back, and prevent its sliding or pressing into the cut. This was done by laying a revetment of 12-inch timber 3 feet high along the edge and anchoring it back by means of tie logs made fast to anchor pieces set from 20 to 40 feet back. The material proved to be so soft that in a few places it was pressed out beneath the revetment and came up in the cut. On March 31 work on this reservoir was stopped to enable the bank to harden and compact itself.

SEWER CANAL.

Attention is again invited to the necessity of action in regard to retaining-walls for the sewer canal.

The large sewer at the foot of Seventeenth street formerly emptied its contents on the flats. As the latter gradually filled up, it became necessary to dig a canal through them. The banks of this canal were too low, however, and the sewage continued to spread out over them when the tide was half up. It became necessary to raise the embank-

ment still higher, to keep the water in the canal from overflowing its banks and to allow the area on each side of it to be filled up with the dredgings from the river. Moreover, the canal had so filled up by deposits from the sewer that there was danger of its being closed up altogether. The only suitable time for a dredge to work in this canal is in the winter. Accordingly, two dredges were employed to go into the canal and dredge it out, depositing the material on each side so as to raise the embankment. The canal was deepened to about 6 feet at low tide, and the embankment made about 6 feet above the same plane. This embankment, at its present height, prevents the sewage from flowing over the flats on either side; but it is only a temporary and unsatisfactory way of dealing with this problem.

On December 2, 1882, I addressed a letter to the Chief of Engineers calling attention to the need of retaining-walls for this canal. There seems to be a question as to whether this work should be done by the General Government or by the authorities of the District of Columbia, but there can be no question that it should be done by some one—the sooner the better. An estimate of the cost of retaining-walls of concrete, built on a pile and grillage foundation, was also submitted. This estimate was $208,144. An extension of the present sewer itself would cost more, and be less satisfactory in my opinion. The sewer is already too low, and to extend it three-quarters of a mile on its present level would be very objectionable. The most effectual means of abating this nuisance will be to establish a large steam-pump at the foot of Seventeenth street and pump the sewage out into the deep water of the river, or even further off if need be. Gates could be established at the end of the sewer to keep out tide-water, while in times of heavy rains they would allow the storm-water to be discharged into the canal. Under such circumstances the only sewage that would be discharged into the canal would be that carried with a heavy rainfall. This plan was suggested by Capt. F. V. Greene, Corps of Engineers, United States Army, assistant to the Engineer Commissioner of the District, and is referred to in his report to the Engineer Commissioner District of Columbia, dated July 1, 1885.

The plan recommended by the Board of Engineers for the improvement of the river front, and upon which the appropriations have been made, contemplates the rebuilding of Long Bridge at an early period during the progress of the improvement, with wide spans upon piers offering the least possible obstruction to the flow of water. No plan of improvement can be made satisfactory while the bridge remains as it is—a serious obstruction to the flow of water beneath it. A large amount of riprap stone has from time to time been placed around the piers for their protection, and, together with the piers themselves, forms a partial dam across the river which will form a gradual deposit of sediment in the river above it. During the past year there has been no appreciable filling up in the dredged channel above the bridge, but there has been no real freshet within that time. The Potomac is a clear river as a rule, but a heavy freshet brings down a large amount of sediment. It is in such times that the bad effects of Long Bridge are mostly felt. When the upper end of Washington Channel is closed, as it is intended to be, provision must be made in the Virginia Channel for carrying off the water that now passes through both. This is to be done by increasing the cross-sectional area of the Virginia Channel, and that is being done both above and below the bridge. Some increase of cross-section, it is true, might be made at the bridge by dredging between the piers, but enough could not be done without endangering the bridge itself. During the freshet of 1877, the discharge area of the

Washington Channel was 10,000 square feet, about one-fifth that of the entire river at the site of the bridge. When this large area of discharge is cut off, as it will be when the fill is made on Section II, the sectional area of the Virginia Channel should be increased by about the same amount. This cannot be done at the site of Long Bridge while it has so many piers set obliquely to the freshet current and protected by an enrockment of stone, reaching, in some cases, almost across the space between them.

The progress made during the past fiscal year has not been as rapid as it might have been by paying much higher prices for the work. The introduction of an entirely new plant, and a new process of doing the work, has somewhat retarded it. As an offset to this, however, the cost, as compared with the first work done, has been reduced at least 33 per cent., and a demonstration has been made of the entire practicability of the new method of dredging. Improvements on the present machines will doubtless follow, and in future the work can be carried on more rapidly. As an evidence of this, it may be remarked that the total amount of dredging done in June, 1885, was 214,138 cubic yards, measured in place, equal to about 265,000 cubic yards measured in scows. This is the largest amount of work accomplished in any one month since the improvement was begun.

The financial statement herewith shows a balance on hand, available for the present fiscal year, of $358,027.93. Except a small sum needed for office expenses, pay of inspectors, &c., all of this is tied up in contracts already made and now in process of execution. Practically, there is nothing available for new work. These contracts are all to be completed by March 16, 1886, and if completed then, a suspension of operations will become necessary.

It is desirable that the next appropriation be a large one, as the improvement has now reached such a stage of progress that it is necessary to complete certain parts as quickly as possible, in order to prevent damage by freshets. Eight hundred thousand dollars could be judiciously expended during the next fiscal year; and if that amount be appropriated, the work may be continued with smaller appropriations hereafter. It is proposed to apply this sum in the continuation of the improvement according to the approved project, by dredging in the Virginia Channel, and filling Section II; by the construction of the inlet and outlet gates; by dredging a part of the tidal reservoir, and by widening the Virginia and Washington channels below Long Bridge.

It is believed that this entire improvement will be completed within the original estimates, if liberal appropriations be made; and when completed, the value of the land reclaimed will be equal to the cost of reclamation.

Washington City is in the collection district of Georgetown, D. C. The amount of revenue collected, and the commercial statistics, were given in the report of the improvement of Washington and Georgetown harbors. Nearest light-house, Jones's Point, Virginia.

Money statement.

July 1, 1884, amount available		$53,141 35
Amount appropriated by act approved July 5, 1884		500,000 00
		553,141 35
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$185,586 57	
July 1, 1885, outstanding liabilities	9,526 85	
		195,113 42
July 1, 1885, amount available		358,027 93

Amount (estimated) required for completion of existing project	$1,816,365 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	800,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

Abstract of contracts for improving Potomac River in the vicinity of Washington, D. C., in force during the fiscal year ending June 30, 1885.

No.	Contractor.	Address.	Date of contract.	Subject of contract.	Price per cubic yard.
					Cents.
1	P. Sanford Ross	Jersey City, N. J	Nov. 17, 1882	Dredging*	21.2
2	Frank C. Somers	Philadelphia, Pa	Nov. 13, 1883	do*	10.8
3	do	do	Aug. 27, 1884	do	10.§
4	Potomac Red Sandstone Company.	Washington, D. C	June 11, 1884	Riprap stone*	87
5	Potomac Red Sandstone Company.	do	Sept. 3, 1884	do*	81
6	D. E. Culver Company	New York City, N. Y	Aug. 11, 1884	Dredging*	11.5
7	Benson & McNee	San Francisco, Cal	Aug. 28, 1884	do	12.37
8	do	do	Sept. 29, 1884	do	15.45
9	do	do	Mar. 16, 1885	do	15
10	G. Vanderwerken	Georgetown, D. C	Mar. 16, 1885	Riprap stone	85

* Completed.

MODIFICATION IN THE DETAILS OF THE PLAN FOR THE IMPROVEMENT OF THE POTOMAC RIVER.

UNITED STATES ENGINEER OFFICE,
Washington, D. C., August 25, 1884.

SIR: In reply to your letter of the 8th instant, relating to the proposed modification in the details of the plan for the improvement of the Potomac River, I would state that the principal modification proposed was in the grade of the filling on Section III.

The Board of Engineers on the improvement of the Potomac River, in their report dated February 18, 1882, recommended "substantially and in its essential features the harbor and shore lines of Mr. Abert's plan from Easby's Point to the Arsenal, and the low-grade filling and surrounding embankment of that plan below the Long Bridge * * * with Major Twining's high-grade filling and sluicing ponds between the Long Bridge and Easby's Point."

Mr. Abert's plan below the Long Bridge provided for filling the reclaimed area to a uniform grade of 6 feet above low water, and surrounding it with an embankment 50 feet wide on top with side slopes of 3 on 2.

The height of the embankment was fixed by the Board of Engineers at 3 feet above the flood slope of 1877, which would make the average height of top of the embankment below Long Bridge 12 feet above low tide.

In Mr. Abert's estimate, however, no provision is made for surface drainage.

The distance between the interior crests of the two embankments, on the Virginia and Washington channels, is about 1,800 feet, and the entire area enclosed by the embankments is about 245 acres. If this large area should be filled to a uniform grade of 6 feet, the rain water would collect in shallow pools, where settlement had occurred, and re-

POTOMAC RIVER
AT
WASHINGTON, D. C.

MAP SHOWING PROGRESS OF WORK
JUNE 30, 1885.

SCALE

— Notes. —

6 ft. curve, ——————

12 ft. " ——————

18 ft. " ——————

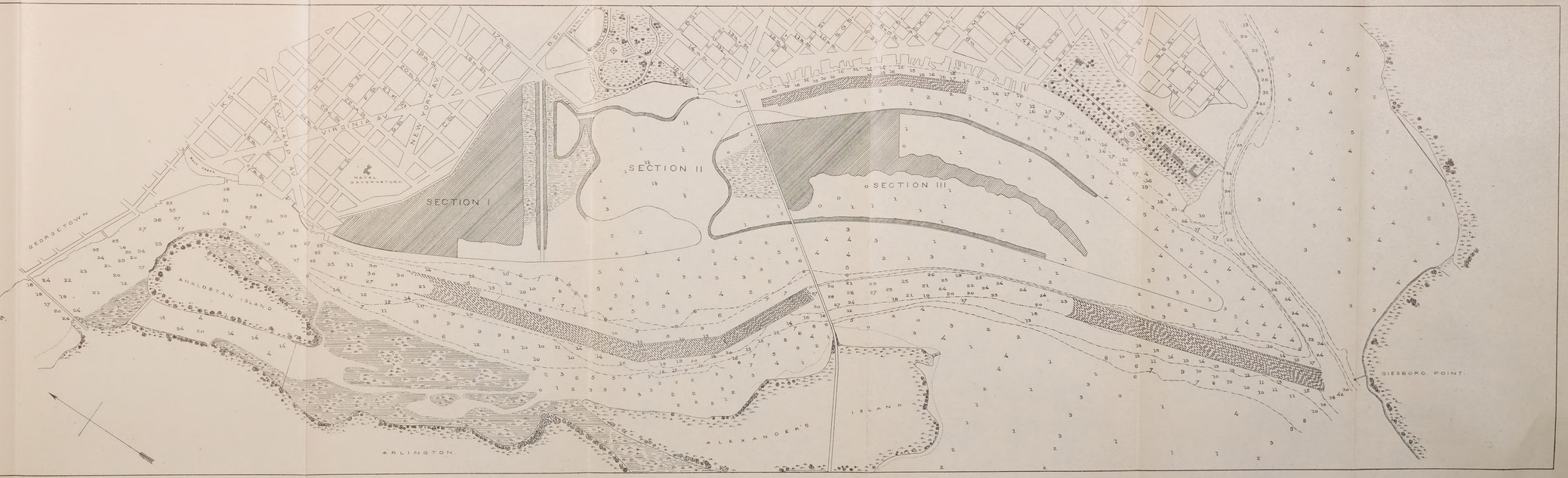
Channel dredged. (to 25 ft. depth)

Fill made on Flats.

Wall, foundation completed. ——

To accompany Annual Report for June 30, 1885.

Thos. C. Haines
Mayor of Engineers.



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main stagnant until it evaporated or percolated through the soil, thus perpetuating in some degree the objectionable features of the existing river flats, and which could only be obviated by an elaborate system of drain-pipes. Even with the flatter interior slopes to the embankment, suggested to the Senate committee by Mr. Abert (but not included in his plan), there would remain a distance of about 1,400 feet between the foot of the two slopes, for the drainage of which no provision is made.

It is, therefore, evident that, should the low-grade filling (6 feet) with the surrounding embankment be adopted, the area within the embankment must be raised in the middle sufficiently to provide efficient surface drainage. As the reclaimed land will eventually be covered with grass, the slopes should not be less than about 6 inches in 100 feet. On the accompanying tracing I have shown, in the first cross-section, the low grade filling with surrounding embankment, the surface within the embankment sloping from the center line to each side on a grade of 6 inches to 100 feet.

Along the interior slope of the embankment provision is made at suitable intervals for subsurface drainage by means of basins and drain-pipes passing under the embankment into the river. These pipes would be provided with flap-valves, working automatically, to prevent the inflow of water during freshets.

There is, however, a grave objection to the plan of low-grade filling, with surrounding embankment, namely, that during high freshets, like that of 1877, the inclosed area cannot be drained at all. This will be evident from an inspection of the first cross-section; so that should rains occur during a freshet (as is usually the case) nearly the entire area will become a pond, which could not be drained until the freshet subsided. Any rise above 6 feet would cause this result over a part of the inclosed area. It was on this ground that there was considerable criticism of the plan by the Senate select committee, as appears in the testimony in Senate Mis. Doc. No. 133, Forty-seventh Congress, first session, pages 12–15.

In view of these facts, I would respectfully recommend the following modification of the grade of filling Section III, viz, that the grade at the wall line around the entire margin of the fill be 6 feet above low water, and that the center of the fill be raised to a grade of 3 feet above the freshet line, as shown on the second cross-section (accompanying tracing). This will give a slope for surface drainage of about 7 inches in 100 feet, and will dispense entirely with the system of levees, drain-pipes, and automatic valves.

It is true that during the highest freshets nearly one-half of the area will be covered with water, but as the surface will be sodded little or no damage will be done.

The amount of dredging required to make the Washington Channel 400 feet wide and 20 feet deep, and to provide a cross-section of 25,000 square feet in the Virginia Channel in accordance with the plan of improvement is about 6,000,000 cubic yards.

This material can be deposited most economically on Section III.

The amount of filling to the grade of 6 feet at the sides and 12 feet in the center is 6,171,000 cubic yards.

I submit below estimates of the total cost of filling Section III by each of the above methods. As these estimates are for comparison, they include the total cost of filling the section, no deduction having been made for the filling already made (about 800,000 cubic yards). For the same reason the contingencies are not included.

ESTIMATE FOR THE TOTAL COST OF FILLING SECTION III, POTOMAC RIVER IMPROVEMENT, TO A GRADE OF 6 FEET ABOVE LOW WATER, WITH EMBANKMENT 50 FEET WIDE AND A GRADE FROM MIDDLE LINE TO FOOT OF EMBANKMENT OF 6 INCHES IN 100 FEET, FOR DRAINAGE (SHOWN IN FIRST CROSS-SECTION).

Dredging 5,747,185 cubic yards, at 18 cents	$1,034,493 30
Drain pipes, basins, &c	40,000 00
	1,074,493 30
The estimate for filling to a grade of 6 feet at the side and 12 feet at the center—as shown on the second cross-section—is as follows:	
Dredging 6,170,896 cubic yards at 18 cents	1,110,761 28
Difference between estimates	36,267 98

The increased cost of the modification which I propose would therefore be only about $36,000.

In making these estimates, the price of dredging has been taken at 18 cents per cubic yard, as in Mr. Abert's original estimates. It is evident, however, from the proposals received on the 20th instant, that the material can be dredged and deposited on this section at a much lower price, in which case the difference in cost would be still less.

Practically there will be no increase in the estimate for the entire work.

There are other obvious objections to the low-grade filling with surrounding embankment, which it seems needless to refer to.

For these reasons I respectfully recommend the adoption of the modified grade.

The second modification in the details of the plan of improvement which I desire to submit relates to the construction of a small lake or tidal reservoir for flushing the sewer canal.

The Board of Engineers, in their report of February 18, 1882, recommended the general plan of flushing ponds above the Long Bridge, "provided with inlet and outlet gates of ample dimensions, automatically arranged for filling the ponds from the Georgetown Channel to the level of high water, and emptying them into the Washington Channel to the level of low water during each oscillation of the tide;" and "that an ample system of drainage for the reclaimed area be provided."

The B street sewer, which receives the drainage of a large part of the city of Washington, has but a slight fall.

It discharges at the foot of Seventeenth street, from which point the sewage is carried across the flats by the sewer canal. This canal is simply an open cut through the marsh, in which the tide rises and falls. Aside from a slight tidal current, there is little force to expel the sewage, except when rain-water causes some head in the sewers above.

When the walls of the sewer canal are constructed as has been proposed, the canal will remain, as at present, a source of foul air and poisonous gases, if not detrimental at least not beneficial to the health of the city, or to the public use of the land in its immediate neighborhood.

In order to obviate this as far as practicable in connection with the work of improving the river, it is proposed to construct, near the foot of Seventeenth street, a small flushing reservoir, 8 or 10 acres in extent (shown on tracing No. 2, accompanying this letter), into which water will be taken from the large tidal reservoir at each tide, to be discharged into the sewer canal by means of sluice-gates.

The object of a separate reservoir is to permit the discharge into the sewer canal under a greater head than is necessary for the discharge into the Washington Channel. This work will be more of an amplifica-

tion than a modification of the plan of the Board of Engineers, and has been contemplated in the various plans and annual reports which I have heretofore submitted. It will secure the discharge of about 1,200,000 cubic feet of fresh water into the canal twice a day. The entire contents of the canal at low water will be about 1,500,000 cubic feet, so that good flushing will thus be secured.

This work will not increase the cost of general improvement, inasmuch as the area about the proposed lake would, in any event, have to be filled by material dredged either from the larger reservoir or the river. Instead of this it is proposed to fill the area adjoining this small reservoir with the material excavated from it. This can be done at a less cost than with material from a greater distance.

At the same time the filling over the area occupied by the reservoir will be saved, and the amount thus saved will pay for the slope-wall, pipes, &c.

The general improvement would be incomplete without a provision for flushing the sewer canal, and I therefore recommend the above modification.

In this connection I would state that Prof. Spencer F. Baird, of the United States Fish Commission, has requested that a space of about five acres be reserved, unfilled, northwest of the sewer canal and near Seventeenth street, for a hatching pond. Professor Baird proposes to request a special appropriation from Congress for building this pond, to be expended under the direction of the officer in charge of this improvement.

The modification in the plan would tend to diminish the total cost of the improvement by diminishing the area to be filled, and as it would facilitate the operations of the Fish Commission I see no objection to its being authorized, and so recommend.

Very respectfully, your obedient servant,

PETER C. HAINS,
Major of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

REPORT OF THE BOARD OF ENGINEERS.

ARMY BUILDING,
New York, October 13, 1884.

GENERAL: The Board of Engineers which, under date the 18th of February, 1882, submitted a plan for the improvement of navigation of the Potomac River in the vicinity of Washington, D. C., the raising of the flats in front of the city, and the establishment of the harbor lines, having been reconvened in this city on the 7th instant, by virtue of Special Orders, No. 124, headquarters Corps of Engineers, Washington, D. C., September 20, 1884, for the purpose of taking into consideration certain modifications in some of the details of that plan proposed by Maj. P. C. Hains, Corps of Engineers, the engineer in charge, have the honor to report as follows:

The modifications proposed, as set forth in a letter addressed to the Chief of Engineers by Major Hains, under date of August 25, 1884, and as orally explained by him before the Board, cover three points:

First. The project of the Board comprised among its essential features the filling of the reclaimed area below the Long Bridge, amounting to about 330 acres, to a uniform grade of 6 feet above low water, having

an embankment or levee around its margin 50 feet wide on top, with its crest fixed at 3 feet above the flood slope of 1877. The reclaimed area was to be provided with an ample system of drainage.

One objection presented by Major Hains to the plan of the Board is that rain-water would remain stagnant on the surface of the inclosed area "until it evaporated or percolated through the soil, thus perpetuating in some degree the objectionable features of the existing river flats, and which could only be obviated by an elaborate system of drain-pipes." In the opinion of the Board this objection is practically groundless, as the only system of drain pipes needed is comprised in the simple but effective method of subsoil drainage in common use by farmers throughout the country for reclaiming wet and swampy ground. This inexpensive method of land drainage applied to the reclaimed area below the Long Bridge would doubtless render it dry and arable, subject perhaps, to occasional but harmless flooding, at long intervals, from the joint effects of freshets and heavy rainfalls.

Another alleged objection to the plan of the Board is that the flap-valve drain pipes through the levee would be sealed by a freshet, and any rainfall which might occur at that time could not be drained off until the flood subsided. It is submitted in reply that this condition of things would last a short time only under the most unfavorable circumstances, not more than eight or ten hours probably at the outside, and no injury would be likely to result from this brief retention of rain-water even if submergence of the inclosed area in quiet fresh water did take place. Indeed, there would be no flooding of the surface at all until the side ditches and subsoil drains became filled and the earth saturated with water. Any ordinary rain-fall, unless ensuing as a climax to a previous wet term, would doubtless be harmlessly absorbed in this manner.

The Jersey Flats lying between the Passaic and Hackensack rivers north of the city of Newark, N. J., are drained in a manner even more simple than the method here indicated. The surface of these flats is on the level of ordinary high tide. Before their reclamation they were barely overflowed twice daily, being thoroughly submerged at every spring tide. After surrounding it with a light dike the inclosed area was cut up into parallelograms by a series of open ditches all leading to an encircling ditch next the dike. Through this dike pipes with flap-valves opening outward were placed at the level of ordinary low-water. The results are that the water in the open ditches never rises above the low-water level, and the land has become dry and firm and is now in use for both agricultural and building purposes.

The proposed modification of this plan of the Board below the Long Bridge is "that the grade at the wall line around the entire margin of the fill be 6 feet above low water, and that the center of the fill be raised to a grade of 3 feet above the freshet-line" of 1877, thus giving to the surface a slope of about 7 inches in 100 feet for drainage purposes, dispensing altogether with the surrounding levee and the drainage system.

It is not the intention to offer objections to this modification of the original plan. Indeed, this method of fill was considered by the Board before the plan was adopted, and although regarded with favor at the time, was not thought to be entirely free from objectionable features.

To state the point under consideration briefly, in contra-position, it may be said that while under certain conditions of simultaneous freshet and heavy rainfall the reclaimed area, if filled on the plan of the Board, may be submerged in still water for a few hours, the same conditions, or

a flood only without rain, would produce submergence in water running with freshet velocities, if the fill be made as now proposed and the surrounding levee omitted. In the former case no serious injury to the surface need be apprehended from either erosion or fill; in the latter most kinds of grass and low shrubbery might be damaged or entirely destroyed by one or both of these causes.

It would seem, therefore, that the proposed change in the method of filling in and raising the flats can hardly be accepted as an improvement on the existing plan, nor does it apparently offer any amelioration of whatever may be regarded as weak or objectionable in that plan.

The Board nevertheless recommends its adoption for the reasons, principally, that should the effect of high freshets upon the surface of the reclaimed area become seriously destructive, or should the width of the stream at the flood-line seem to need contraction for purposes of channel maintainance or improvement, the levee can be added at any time as a remedy.

Second. The Board concurs in the recommendation of the engineer officer in charge that a tidal reservoir of 8 to 10 acres in area be provided for flushing the sewer canal leading from the outlet of the B street sewer at the foot of Seventeenth street to the Virginia Channel.

The Board is of opinion that this canal will eventually have to be covered over to prevent its becoming an offensive, if not an unhealthy, feature of the locality.

The Board also concurs in the recommendation that a site for a hatching pond be reserved, agreeably to the request of Prof. Spencer F. Baird, of the United States Fish Commission, and as shown on the map submitted by the engineer in charge, it being the understanding that all the expense connected with the construction of the pond is to be provided for by special legislation.

Major Hains's letter hereinabove referred to, and two tracings accompanying the same, are herewith returned.

Respectfully submitted.

Q. A. GILLMORE,
Colonel of Engineers, Bvt. Maj. Gen., U. S. A.
C. B. COMSTOCK,
Lieut. Col. of Engineers, and Bvt. Brig. Gen.

I concur in the *recommendations* of the Board as stated above. At the session of the Board in February, 1882, I suggested the plan of raising the flats in the central portion and of surface drainage towards the edge of the reclaimed area, essentially as now proposed by the local engineer. My distinguished colleagues on the Board preferred the treatment then recommended by the Board. I preferred the other as suggested by me, but deemed theirs sufficient, and as the cost of the two methods was about the same, as unanimity was then quite important, and the report then submitted contemplated further study of details, I yielded my opinion to theirs.

Respectfully submitted.

WM. P. CRAIGHILL,
Lieutenant-Colonel of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

J 3.

IMPROVEMENT OF THE JAMES RIVER, VIRGINIA.

The improvement of the navigation of the James River was regularly undertaken by the Government in 1870. A small sum had been expended previous to 1855, under the direction of Colonel De Russy, Corps of Engineers, U. S. Army, and resulted in some advantage to navigation.

The first regular appropriation was made in 1870, and since that time other appropriations have been made and expended, aggregating the sum of $720,773.78. Since 1870, the city of Richmond has also expended no less than $432,171.98.

The work has been under the continuous charge of Lieut. Col. William P. Craighill, Corps of Engineers, United States Army, from its commencement until July 24, 1884. when it was transferred to me, in accordance with orders received from the office of the Chief of Engineers, dated July 11, 1884.

When the improvement was undertaken by the Government, navigation was obstructed by sunken vessels, by remains of military bridges, and by obstructions purposely put in the river during the late war to prevent the national fleets from approaching too close to Richmond. There were, besides, natural obstructions. Rocketts Reef and Richmond Bar had only 7 feet of water at mean low tide; from Warwick Bar (where the depth was 13 feet) to Richmond the channel was crooked and obstructed by dangerous rocks and ledges. The Dutch Gap Cut-off, which now saves 5½ miles of difficult navigation, was not then open.

The original project was to secure a depth of 18 feet at full tide, corresponding to 14.5 feet at low tide, to Richmond, with a channel width of 180 feet from Harrison's Bar to Richmond Docks, the excavation in rock to be 18½ feet at full tide. This project was well advanced, when Congress, by act approved July 5, 1884, adopted the project of 22 feet at mean low tide from Richmond to the sea. Operations during the past year have been conducted with that object in view.

In carrying out the new project a large amount of excavation will be in solid rock, and the cost will necessarily be great. The width to be given to the channel is 400 feet from the sea to City Point; 310 feet from City Point to Drewry's Bluff, and 200 feet from thence to Richmond.

The methods employed during the past year for improving the river consist in dredging, rock excavation, and contraction of water-way by means of dikes or jetties. Some of the work has been done by contract, and some by day's labor, using machinery belonging to the United States and to the city of Richmond. This method appeared to be more advantageous to the Government at certain places. The shoal that gave the least depth of water, in the lower part of the river, was at Swan Point. The depth here was 16½ feet at mean low tide. The deepening of this channel would give 19½ feet at full tide as far up as Kingsland's Reach. There were, besides, certain local features of the river in this locality that induced the hope that a dredged channel would be permanent without works of contraction. The current here is quite swift, attaining a velocity of 2.3 feet per second (see Annual Report for 1882). The dredged channel would be parallel to the current, both in flood and ebb tides. The bottom seemed from the examinations made to be a thin crust of hard material underlaid by very soft mud; and the bar itself was in close proximity to water from 40 to 50 feet deep. Accordingly, it was

determined to dredge a cut through this shoal not less than 100 feet wide and 20 feet deep at low tide. Future observations will be made to determine whether it remains permanent.

Proposals for doing this work were invited by public advertisement, and the following bids received:

Abstract of proposals opened by Maj. Peter C. Hains, Corps of Engineers, at Washington, D. C., September 10, 1884, *for dredging near Swan Point, James River, Virginia.*

No.	Names and addresses of bidders.	Estimated number of cubic yards.	Price per cubic yard.	Amount.
			Cents.	
1	Thomas P. Morgan, Washington, D. C	180, 000	$14\frac{4}{10}$	$25, 920
2	Geo. E. Ward, Washington, D. C	180, 000	$12\frac{35}{100}$	22, 230
3	Ross & Sanford, Jersey City, N. J	180, 000	13	23, 400
4	James Caler & Son, Norfolk, Va	180, 000	23	41, 400
5	Daniel Constantine, Baltimore, Md.*	180, 000	$10\frac{9}{10}$	19, 620
6	New York Steam Dredging Company, New York City, N. Y	180, 000	26	46, 800
7	National Dredging Company, Wilmington, Del	180, 000	$14\frac{1}{2}$	26, 100
8	American Dredging Company, Philadelphia, Pa	180 000	14	25, 000
9	Morris & Cumings Dredging Company, New York City, N. Y	180, 000	$11\frac{7}{8}$	21, 375
10	Thomas Potter, Jersey City, N. J	180, 000	$18\frac{3}{4}$	33, 750

* Contract entered into with Daniel Constantine; dated September 23, 1884. Completed.

The contract was awarded to Daniel Constantine, of Baltimore, Md., the lowest bidder. He commenced work on January 9, 1885, and completed his contract May 28, 1885; excavating 153,191.6 cubic yards, at a cost of 10.9 cents per yard.

For the benefit chiefly of the largest class of vessels, it was determined to widen Dutch Gap. The project adopted by Congress contemplated a width of 300 feet. Bids had been invited in October, 1883, for this work, but only two were received, and these were regarded as exorbitant in price. They were rejected, and the plan of doing the work by hired labor and the use of the appliances on hand determined on. The bluff is 50 feet above mean low tide. The upper layer is ordinary earth; below that is a layer of gravel and bowlders, mixed with loam; and below that, compact black clay, too hard to be excavated by a dredge, unless it be first shattered and disintegrated by blasting. The plan adopted for doing the work was to wash down the two upper strata by means of jets from a large force-pump. The surface of the clay was thus exposed at a height of about 10 feet above low tide. This was broken up and disintegrated by means of blasts of dynamite fired in holes drilled by ordinary diamond-drill tools. The material was then ready for the dredge; which excavated in all, about 46,750 cubic yards. The total cost of the work was $17,254.12, an average of 37 cents per cubic yard. The lowest bid received for doing this work was $82\frac{1}{2}$ cents per cubic yard. The excavation of 46,750 cubic yards does not represent the full amount of work done—for in that, no account is taken of the light material which was carried away by the current of the river after being washed down by the pump. There is now a clear channel through the gap 300 feet wide and 18 feet deep at mean low tide. It is probable that it will need no further widening, but it should be deepened when the river has been further improved at other places.

At Randolph Flats the work consists of dike building and dredging. The dike is a longitudinal one, connecting the ends of the jetties, and

is built of brush and stone to the level of low water. It seems to answer its purpose well, besides being of cheap construction. The brush was obtained along the river at 50 cents per cord, and the stone was supplied from the work going on at Goode's Rocks. About 4,485 linear feet of dike were built, using over 2,000 cords of brush and 979 piles. One of the dredges belonging to the city of Richmond was kept at work on this shoal over three months, excavating 36,535 cubic yards of gravel, sand, and bowlders. There remains considerable dredging yet to be done, as there was a large deposit of sand during the freshets that occurred in May. There were two freshets within a few days of each other, and though neither of them reached the height of 10 feet above mean low tide, they brought down a large amount of sand and sediment.

At Goode's Rocks work was commenced under the new project, the material being mostly bed-rock, with some sand, gravel, and loose bowlders. As it is not profitable to go a second or third time over ground in blasting operations, the excavation was carried to the full depth of 22 feet at low tide. Of course, with the comparatively small sum available for this work, but a small percentage of the entire amount could be accomplished. To the extent of the work done progress was satisfactory. Besides 2,609 linear feet of brush dike built, there was removed by dredge 206 cubic yards of gravel, cobbles, and decomposed rock, broken up by blasting, and 898 cubic yards of rock too large to be handled by a dredge were taken out by a hoister. The rock was used in building dikes and jetties.

At Brewery Cut only a small amount of dike building was done.

At Rocketts Reef but little work was done, as there is already 18 feet at full tide. The work consisted in widening the channel, in continuation of the work of the previous fiscal year.

Work at Gillies Creek Shoal was carried on for several months with the city dredges. This shoal has long been a serious obstruction to navigation. It was found to consist of bowlders, sand, gravel, and rock, a part of the latter being a sort of rotten granite and the remainder firm granite. There were removed 205 cubic yards of sand, 14,449 cubic yards of decomposed rock and gravel, 1,055 cubic yards of broken rock, twenty-eight bowlders, and two logs. The general depth made was 18 feet at low tide, but some shoaler lumps were left, as the dredge, unaided by blasting, could not remove them.

The disposing of spoils in dredging the upper part of the James River is fast becoming a serious problem. Annual dredging is necessary to remove the deposits of freshets. The areas between the spur-dikes, built to contract the width of the stream, have heretofore been the dumping-ground for all dredgings, and they have been of great value in that way. These spaces, however, are now becoming filled up, so that dumping-scows of the lightest draught can only get in at high tide, and in many places cannot get in at all. It is necessary to find new dumping-grounds, or the material must be transported in some other way. The latter is doubtless the better plan, particularly as the time approaches for connecting the ends of the jetties by longitudinal training-dikes, and when this is done the spaces referred to will be closed in. The hydraulic dredge, such as is used in the improvement of the Potomac River, will answer well in this case. A machine capable of taking out 2,000 or 3,000 cubic yards per day could be built for about $25,000. Its operating expenses would not exceed those of a dipper dredge, doing one-fourth the amount of work.

It has been estimated that at least 275,000 cubic yards of solid matter passes "Rocketts" in twenty-four hours when there is a freshet not higher than 10 feet. No account is taken in this estimate of the heavy material rolled along the bottom. It is probably far within limits to say that in such a freshet not less than 300,000 cubic yards passes, and in higher freshets the amount is correspondingly increased. Fortunately, a freshet does not as a rule last more than a few days, and but few occur each year. The amount of solid material brought down from above, however, is large. It varies greatly each year, and its amount is difficult to estimate. Large quantities of the lighter particles held in suspension are carried far down the river, but the heavier portions that roll along the bottom, moved only by a rapid current, stop as soon as the freshet subsides, and must be taken out by dredging or allowed to impede navigation. It is therefore believed that it will be necessary in the future, as it has been in the past, to keep on hand a dredging plant ready for emergencies. An ordinary sand scow adrift in a freshet may sink in the channel of the river and cause the formation of a bar impassable to even ordinary vessels. In the same way the sinking of a coal barge is liable to block the channel at any time. These accidents are of frequent occurrence. The city of Richmond, appreciating the necessity for prompt removal of such obstructions, and with a view to aiding the operations of the Government, has for some years kept on hand two dipper dredges, with the proper accompaniment of scows and tugs. These have been freely used, with advantage and economy, by the Government in its operations.

The present condition of the improvement may be stated as follows: There is 19½ feet of water at full tide from the sea to Kingsland's Reach, 18 feet from thence to Randolph Flats, and 17 feet from thence to Richmond. At Dutch Gap no attempt has been made to increase the depth, but the width of the cut has been increased to 300 feet, a width sufficient to accommodate the largest class of vessels that can navigate the river above. There has been expended on the new project, the estimate for which is $4,500,000, the sum of $77,976.38.

To make reasonable progress in an undertaking of this magnitude large annual appropriations will be necessary. It must be borne in mind also that a sum variously estimated from $15,000 to $30,000 will be needed annually to remove the deposits of freshets; $400,000, therefore, would seem to be a moderate sum to apply in execution of this project. This amount could be profitably expended in the fiscal year 1887.

Money statement.

July 1, 1884, amount available		$29,235 86
Amount appropriated by act approved July 5, 1884		75,000 00
		104,235 86
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884		84,979 64
July 1, 1885, amount available		19,256 22
Amount (estimated) required for completion of existing project	4,402,767 40	
Amount that can be profitably expended in fiscal year ending June 30, 1887	400,000 00	
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

REPORT OF MR. C. P. E. BURGWYN, ASSISTANT ENGINEER.

ENGINEER OFFICE,
Richmond, Va., June 30, 1885.

MAJOR: I have the honor to submit the following report on the improvement of the James River, Virginia, for the year ending June 30, 1885:

At the close of the last fiscal year operations were being conducted on the James River with the machinery belonging to the United States and to the city of Richmond. Efforts had been made to do the work in the neighborhood of the city of Richmond by contract, but it was found impossible to do so, for the following reasons: The work is situated in a narrow river, with a current ordinarily moving both up and down, according to the state of the tide, but subject to a sudden variation of velocity of from 4 feet to 6 feet per second in times of freshets. The river bottom varies from quicksand, through different stages of hardness of bottom, such as gravel, cobble-stones, blue clay, decomposed rock, and finally there are many localities where the solid garnet-bearing granite is encountered, and from which it has to be removed. The position of the rock is sometimes under that of the sand. Past experience has demonstrated that it is folly to dredge a channel through the sandy reaches of the James River, near Richmond, where there is this excessive freshet velocity, without at the same time contracting the width of the river. The problem of the proposed width to be given the river at the various points has been carefully studied for a number of years, and its solution is believed to have been arrived at within a close approximation.

It has also to be borne in mind that the reduction of the width of the river creates a scour, which will deposit itself below the location of the narrowing works. This second problem, viz, of taking care of the scour, is so intimately connected with the first that their solution has been simultaneously investigated; and in all cases where the river has been narrowed, reducing the cross-sectional area by contraction, attempts have been made to restore the cross-sectional area to its original quantity by deepening the river by dredging the included area. Were the river properly narrowed by suitable artificial means, and were the channels dredged through the sand (unless there was also the same depth over the rocky ledges), the draught obtained over the sand-bars would not be obtainable above, and hence the improvement would be unprofitable for navigation. On the other hand, the heavy material obtained in the removal of the rocky ledges is the very thing needed to protect and hold in place the artificial works of contraction. It follows from this that the rock operations, the operations of dike-building and construction of jetties, and the dredging of sand-bars should be carried on simultaneously. The adjustment of this work is so delicate that were the various parts let out to different contractors and were one to fail in executing the work allotted him it would entail disastrous results upon all the rest. The failure to obtain a proper contractor for works of so varied and complicated a nature had led to the prosecution of this work by the machinery belonging to the Government and to the city of Richmond during the previous year, and work was being carried on under this scheme when the present year began. It will be shown later on that the work prosecuted in this manner has resulted in the saving of several thousands of dollars over the prices bid by the contractors, besides saving valuable time. The city of Richmond, recognizing the vital importance of the improvement of the river trade, has spent also a large sum of money upon the work. A very intelligent committee is appointed, who are authorized to keep their dredges, pile-drivers, tow boats, &c., in good condition, and who give the use of their machinery to the Government, whenever requested to do so, free of charge. They exercise a general supervision of the river, and should a shoal be suddenly formed by a freshet they have the appliances ready for its prompt removal.

During the past year work was prosecuted under the above-mentioned scheme at the following places: Gillies Creek Shoal, Rocketts Reef, Brewery Cut, extension of jetties, Goode's Rocks, Randolph Flats, Dutch Gap, and near Swan Point.

At Gillies Creek work was carried on with one dredge during the months of July, August, September, October, and until November 8, and with an auxiliary dredge during October and until the last date. This shoal has been an impediment to the proper maneuvering of vessels in the harbor ever since the settlement of the place. For a period of fifty years it has been worked upon at different times and with various degrees of success. It was first supposed to be the gravel washings from the creek, and one scheme, executed many years ago, was to build a high dam across the mouth of the creek, under the expectation that this would prevent further washings into the river, and that the shoal in the river would then wash away. The result of this was that the creek filled its bed up to the top of the dam, and things were then in the same condition as before. During the past year's operations the dredges were able to break through the greater part of the shoal. The larger part of it proved to be composed of cobble-stones and decomposed rock. The material dredged was utilized in weighting down the brush dike built at Goode's Rocks and Randolph Flats.

The depth of 18 feet at low water was made over the greater part of the shoal, but several lumps of rock were encountered too solid to be ripped up by dredges. These still remain. Drilling and blasting will be necessary to obtain the above-mentioned depth throughout. As the amount allotted to this work was expended before the last cut was put through, it would be judicious to complete the work at a later period. There were removed 205 cubic yards of sand, 14,449 cubic yards of gravel and decomposed rock, 1,055 cubic yards of broken solid rock, twenty-eight bowlders, and two logs.

Work on Rocketts Reef consisted only in widening it. The present depth, 18 feet at high tide, 14½ feet at low tide, being greater than what existed below, it was only judicious to widen the present channel, spending at this locality as little as possible. In this connection it may not be uninteresting to compare the methods now pursued at this reef with those pursued a quarter of a century ago. Then the method was to hoist a heavy iron ram up on the gin of a pile-driver and allow it to descend free. The effect, if any, was sometimes to chip a little piece off the rock. When the rock became flattened out on top, recourse was then had to hand-drills and blasting powder. This, compared with the diamond and percussion drill, and dynamite as an explosive, well exemplifies the rapid progress of modern submarine engineering. The rock force was employed here during the month of June, 1884, until the 12th of that month. The dredge was put upon the reef from June 19 to July 27, 1884. The method of drilling, blasting, hoisting the rock by chains, and dredging it has been so well described previously that a repetition here is deemed unnecessary. As vessels pass this locality daily, and no trouble is reported, it is believed that a widening sufficient for present purposes was effected. No detailed survey was made after the work was finished.

The work of the extension of the jetties in the neighborhood of the brewery was the completion of the scheme of reduction of the width of the river previously shown to be necessary. This scheme contemplates running the jetties about at right angles from the shore out into the river as far as necessary, and then dumping the dredged material in behind them. When the inclosed area has been sufficiently filled up by material deposited in this manner the scheme further contemplates connecting the ends of the jetties by longitudinal dikes. Sixty piles were driven and 680 linear feet of jetty were built. This completed the contemplated extension of the jetties, and as they have been thoroughly revetted with the rock dredged at Gillies Creek and Rocketts Reef, and have stood the winter's ice and spring freshets, the jetty part of the work is believed to be permanently completed.

As the scheme on which the improvement of the James River is being conducted contemplates a channel 22 feet deep at low water, the channel through Goode's Rocks was selected as a place to commence work, looking toward this depth as the ultimate result. The area to be improved was carefully sounded, and the question studied, in order to lay down the channel lines to the best advantage. It is to be observed here that several elements enter into the problem. In the first place, the work must be executed in a channel in almost hourly use by vessels navigating the river; second, there is, in times of freshets, a cross-current that sets obliquely over the cut; and, third, the sand from above is continually being washed down, filling up the holes that have been drilled and settling around the bit as it is drilling the holes. These difficulties were obviated in the following manner: By careful borings it was seen that the channel could be thrown about 50 feet further toward the southern side of the river; this greatly improved the curvature, and although it necessitated taking out a deep cut in one place, the material was found to consist of cobble-stones and bowlders to a great extent. On account of the channel-line having been moved over this 50 feet, vessels could navigate the old channel while this new 50-foot channel was being excavated. To rectify the cross-currents, a brush dike 2,809 feet was built. Beginning some distance above, and following the curve of the river, it passed by the line of cut in approximately a parallel direction, and was continued some distance below. This longitudinal dike was connected with the bank at various places by jetties and by joining on to the Quarry Wharf. It has answered its purpose well. To keep the sand away from the drill-holes a force pump of considerable power was used. The diver, by holding the nozzle close to the rock, clears the sand from the top, and then by taking it alongside the drill-rod in a proper manner it is possible to keep the hole clear. After a hole had been drilled a wooden plug which had been made to fit it was driven in sufficiently tight to keep the sand out, and a line was led from it to the top of the water. The hole was recovered, when wanted, by following the line, when the plug was removed and the cartridge inserted. As the length of the cut is about 1,000 feet, and as only $20,000 were available, although a large amount of work was done in drilling, blasting, and excavation, yet this could not result in completing any portion of the work. As the cost of completing the Goode's Rock work is estimated at about $539,000, an expenditure of only $20,000 could execute only a small percentage of the total amount. The work accomplished was as follows: Three hundred and seven linear feet of jetties built, using 2,345 cords brush and 593 piles; 2,609

linear feet of brush dike built; 206 cubic yards of gravel and decomposed rock and 1,100 cubic yards of solid rock dredged; 1,881 linear feet of holes were drilled (aggregating 168 holes), and 1,530 pounds of dynamite used. The rock force hoisted 898 cubic yards of rock, and were employed on the work from June 12 to December 5, 1884. One dredge was employed from November 8, 1884, to February 8, 1885.

The operations at Randolph Flats consisted of dredging sand and a continuation of the brush dike. Various forms of dike, parallel to the current, have been used on the river. The objections to all them, except the brush, is the difficulty of preventing the heavy scour of a 6-foot-per-second current from undermining them, and the liability of the waves from the large steamers washing them up. When a side-wheel steamer passes it creates a wave about 4 feet high from top to bottom of the wave. This, alongside the dike, will make a difference in elevation between the shore-side and river-side of it sufficiently great for the water to pass through it from one side to the other. In this case, should a breach be made, the dike will wash up or give way. It had in past experience often happened that in building a log or plank dike there was a liability of a small hole occurring where the log or plank rested on the bottom. In a short time this would be washed out to large dimensions by the wave action of the passing steamers, and as they were constantly passing, both day and night, this undermining was an unending source of trouble. The brush dike will break up the wave action, and it cannot undermine on account of its construction, which is as follows: Two rows of piles are first driven, 6 feet apart, the piles in each row being about 8 feet from center to center; at right angles to the rows of piles loose brush is placed, so that the butt ends will just lap inside the inner rows; this brush generally consisted of young pine trees from 30 to 40 feet long. When this brush got to be about 2 feet or more thick it was weighted down with the rocky material obtained from the dredging at Gillies Creek and Goode's Rocks. As about 3,000 tons of this material were available from the dredging, ample means were at hand to secure the brush in place. After the bottom course of brush was sunk, the larger pieces of rock, weighing from 1 to 10 tons, were put on the river-side of the rows of piles on the outlying brush. Then, between the two rows of piles, brush was laid crosswise to the bottom layer, viz, parallel to the current. This second course was weighted down, another course put on the top of it, and so on until the dike was built up sufficiently high. The tops of the adjacent piles were then sprung together and fastened with wire. It will be observed that the bottom courses of brush are independent of each other; that is, while they are able to move vertically downwards they cannot move in any other way. Therefore, should the dike commence to undermine at any place this bottom course of brush will sink into the hole and prevent any further undermining; at the same time the brush on top will sink down and occupy the place of the bottom courses. This will show itself on the surface of the water, where enough brush can be added to the dike to fill up the space left vacant by the sinking of the top course. It is very curious to observe the phenomena when a wave from a steamer strikes the brush dike A retardation of the shore end of the wave seems to take place, and this draws the line of wave along the dike. Only a gentle undulation takes place in behind the dike, and the undulations in the river appear to be quelled, just as the vibrations of a tight string are stopped by coming in contact with a clamper. The undulations are not reflected from the surface of the irregular dike, but appear to be absorbed. In addition to building the dike, one dredge was employed from November 8, 1884, to the end of that month, and again from February 8, 1885, to March 6, and from May 11 to the end of the fiscal year. During this time there were dredged 36,535 cubic yards sand and four bowlders; 60 linear feet of jetty were repaired and 4,485 linear feet of brush dike built, using 2,030 cords of brush and 979 piles.

The amount of curvature at Dutch Gap, combined with the rapidity of the current, having rendered this cut off a dangerous passage for the large class of vessels now navigating the James River, it was determined to widen the gap. Proposals were therefore issued and the bids were opened October 10, 1883. Only two bids were received, 82½ cents and $1.20 per cubic yard. As these prices were deemed too high they were rejected, and in February, 1884, the method of the hydraulic grader was used. As this proved so successful, and as later on a survey demonstrated that the material washed down had no deleterious effect upon the channel, it was decided to continue that method of work. The preparations necessary were few, and consisted chiefly in the purchase of a powerful boiler and its steam fittings and connections. The bluff to be moved was 50 feet above mean low water, and the excavation was to be carried to 18 feet below that level. Commencing about 10 feet above low water, and from thence downward, a hard, compact blue clay, or indurated earth, is met with, which is unprofitable to dredge in its natural state. From the 10-foot plateau to the top of the bank the material is compact gravel and a stratum of loam, cemented by streaks of the oxides and sulphides of iron. The best method of carrying out the improvement required careful study. It was solved in the following manner: There were available two diamond drills, several boilers on lighters, two powerful force-pumps, one dredge, and one tug-boat. By means of earth augurs on the top of the

bluff, holes were readily sunk from about 10 to 15 feet deep, loaded with small charges of dynamite and fired. This loosened the loamy material to some extent; then one of the force-pumps kept a stream of water on the top of the bluff. This permeated all through the loam and softened it to such an extent that when the force-pump undermined the bank it fell down in small pieces. Unless this softening had been done the bank would have fallen down in layers too large to be handled. The force-pump on the face of the bank cleared the gravel and loam from off the clay stratum, running the material off in the deep hole below the gap. This left the clay stratum perfectly bare. Advantage was then taken of the diamond drills, and holes were bored into the clay from 30 to 35 feet deep, loaded with dynamite and fired. Great skill was required in boring the holes to prevent their filling in as soon as the drill rod was removed. The bitts used were the regular diamond-drill bitt, except that instead of diamonds steel teeth were inserted. Quite often these teeth crushed the gravel that would be met with in some of the seams or cut through layers of iron pyrites. In these cases the steel teeth, half an inch thick, would be worn entirely away; they were set into the bitts so as to leave no core. Only comparatively few holes were lost on account of the caving in of the sides. After the holes were fired no difficulty was experienced in dredging. The drilling and pumping was done with the rock-force during the months of December, January, and February; and the dredging during the months of December, January, February, March, April, and May. The gap was widened to 300 feet at its minimum point, and the approaches enlarged. There remains a large area over which blasting has been done, and which can be readily excavated hereafter, but it is believed that the condition of the gap is amply sufficient for the present needs of commerce.

The amount of material reported as moved only includes what was dredged and deposited in the bend by dump-lighters. In addition to this, there was a large quantity washed away by the pump, of which no account is taken.

Total number of cubic yards dredged		46,750
Total number of linear feet drilled		3,831
Total number of holes fired		129
Total number of pounds of dynamite used		2,803
Average depth of holes drilled	feet	29.7
Average pounds of dynamite to hole		21.7

The main force-pump used, was a double-acting single cylinder pump: Steam cylinder, 24-inch diameter, 24-inch stroke; water cylinder, 10-inch diameter, 24-inch stroke; suction, 6-inch diameter; steam supply, 3-inch diameter; steam discharge, 4-inch diameter.

Water was discharged from four 2-inch diameter openings and one 3-inch opening. Each opening had its own valve, and the discharge could be concentrated in any one of the openings or allowed to pour out of all of them. Each opening was coupled to its separate line of hose. The pipes of the 2-inch hose were 3 feet long and seven-eighths inch diameter of nozzle. The pipe of the 3-inch hose was 3 feet long and 1½ inches diameter, reducible to 1 inch diameter of nozzle. The pump was worked at a speed of sixty strokes per minute. The boiler was of the locomotive pattern; shell of steel three-eighths inch thick, 21 feet long, 52 inches diameter; fire-box 78 inches long by 43 inches wide by 54 inches high; the tubes were 12 feet long, 3 inches diameter, and 70 in number. The exhaust of the pump could be put into the smoke-stack of the boiler.

As the reasons for executing work near Richmond by day's labor do not apply to the lower reaches, proposals for excavating the material at Swan Point were invited, and a contract was entered into with Mr. Daniel Constantine, of Baltimore, who commenced work January 9, 1885, and completed it May 28. The total quantity of material moved was 153,191.6 cubic yards. A channel 100 feet wide and 20 feet deep at low water was made entirely through the shoal. At the lower end the width was increased to 150 feet, and the depth to 22 feet at low water. The material consisted of soft mud, mixed with a little sand at the lower end. It is believed that a slight scour is taking place where the depth of cutting was sufficiently great to make a difference in the velocity of the current. The cutting through of this bar enables vessels drawing 19½ feet to navigate the river as far as Kingsland's Reach. Advantage of this has already been taken by coastwise steamers. Those which now ascend the river seeking cargoes are of larger dimensions than have ever come up before.

A survey was made at Gillies Creek by stretching a wire and sounding every 10 feet across in lines 20 feet apart. After the dredging was finished cross-sections were also taken in June by stretching a wire across at each jetty. Also the usual survey was made from Drewry's Bluff to the ship locks in lines 100 feet apart, the distances being determined by intersecting angles from two transits.

The results of the year's work are as follows:

The deepening of the channel through Swan Point so that vessels drawing 19½ feet can ascend the river as far as Kingsland's Reach; the widening of Dutch Gap to an

amount sufficiently great, viz, 300 feet, to accommodate not only the vessels now navigating the river, but the probable enlargement in size of vessels for some years to come; the excavation of a large amount of sand at Randolph Flats, rendered necessary by the proposed contraction at that point; the building of long brush dike from Randolph Flats to Goode's Creek, and excavation of a large amount of material at Goode's Rock; the widening of Rocketts Reef, and the completion of the jetties in its vicinity, and the excavation of Gillies's Creek shoal. The survey from Drewry's Bluff to Richmond shows that the least depth in the channel in this section of the river is 13½ feet at low tide, equivalent to 17 feet at high tide. Allowing 1 foot keeway, vessels should come up drawing 16 feet. The usual practice is about 15½ feet.

Accompanying this report, and forming an important part of it, are appended tables showing the amount of work executed at each locality and its cost, tables of the physical characteristics of the river, statistics of the tonnage of vessels navigating the river, and the quantities of material moved by private parties.

I have the honor to be your obedient servant,

C. P. E. BURGWYN,
Assistant Engineer

Maj. PETER C. HAINS,
Corps of Engineers, U. S. A.

Gillies Creek Shoal.

Date—1884.	Cubic yards.			Number of—		Amount expended.
	Sand.	Decomposed rock and gravel.	Solid rock.	Bowlders.	Logs.	
July	195	1,880	100	.....	.....	.....
August	10	3,010	155	.....	.....	.....
September	.....	3,098	425	28	2	.....
October	.....	5,171	120	.....	.....	.....
November	.....	1,291	255	.....	.....	.....
Totals	205	14,450	1,055	28	2	$5,668 01

APPROXIMATE RATES.

205 cubic yards sand, at 15 cents.
14,450 cubic yards decomposed rock and gravel, at 24 cents.
1,055 cubic yards solid rock, at $2.
28 bowlders, at $5.
2 logs, at $5.

NOTE.—The contract price offered for this was $1.50 per cubic yard, lump amount. The 15,709 cubic yards at $1.50 = $23,563.50; hence a saving was effected of $17,895.49, besides utilizing the heavy material for revetting.

Rocketts Reef.

Date.	Cubic yards.		Amount expended.
	Decomposed rock.	Solid rock.	
July, 1884	815	280	$863 25

APPROXIMATE RATES.

815 cubic yards decomposed rock, at 25 cents.
280 cubic yards solid rock, at $2.32.

Brewery Cut.

Date.	Number of piles driven.	Linear feet extension of jetty.	Amount expended.
July, 1884	60	680	$1,151 59

APPROXIMATE RATE.

680 linear feet extension jetty, at $1.70.

Goode's Rocks.

Date.	Cubic yards.			Linear feet.			Number of--				Amount expended.
	Dredged.		Hoisted.								
	Gravel and decomposed rock.	Solid rock.	Solid rock.	Jetty built.	Brush dike.	Drill holes.	Holes fired.	Pounds of dynamite used.	Cords of brush used.	Piles driven.	
July, 1884	.....	.....	175	.....	.....	410	37	361	.....	.....	.....
August, 1884	.....	.....	240	.....	369	418	40	339	.....	96	.....
September, 1884	.....	.....	175	187	185	276	21	223	840	447	.....
October, 1884	.....	.....	150	120	1,090	362	30	271	805	50	.....
November, 1884	19	296	120	.....	965	363	22	196	700	.....	.....
December, 1884	109	534	30	.....	.....	52	18	140	.....	.....	.....
January, 1885	31	157	.....	.....	.....	.....	.....	.....	.....	.....	.....
February, 1885	47	113	.....	.....	.....	.....	.....	.....	.....	.....	.....
Total	206	1,100	890	307	2,609	1,881	168	1,530	2,345	593	$19,373 93

APPROXIMATE RATES.

206 cubic yards gravel and decomposed rock, at 40 cents.
1,990 cubic yards solid rock drilled, blasted, and raised, at $6.81.
307 linear feet jetty, at $1.70.
2,609 linear feet brush dike, including revetting, at $2.

Randolph Flats.

Date.	Linear feet.		Number of—				Amount expended.
	Brush dike.	Jetty repaired.	Cords brush.	Piles driven.	Bowlders raised.	Cubic yards sand.	
July, 1884	800	.....	600	359	.....	.....	.....
August, 1884	2,035	.....	720	298	.....	.....	.....
October, 1884	.....	.....	.....	.....	.....	200	.....
November, 1884	.....	60	.....	.....	4	10,960	.....
December, 1884	650	.....	282	.....	.....	.....	.....
February, 1885	.....	.....	.....	.....	.....	4,725	.....
March, 1885	.....	.....	.....	.....	.....	1,000	.....
May, 1885	.....	.....	.....	.....	.....	3,350	.....
June, 1885	.....	.....	.....	.....	.....	16,300	.....
Total	3,485	60	1,602	657	4	36,535	$10,104 81

APPROXIMATE RATES.

3,485 linear feet brush dike, including revetting, at $1.50.
60 linear feet jetty repaired at $2.15.
36,535 cubic yards sand, at 13 cents.

Dutch Gap.

Date.	Linear feet drilled.	Number of—			Amount expended.
		Holes fired.	Pounds dynamite.	Cubic yards blue clay.	
December, 1884	386	19	344	9,035	.....
January, 1885	1,720	56	1,258	7,950	.....
February, 1885	1,725	54	1,201	11,025	.....
March, 1885	.....	.....	.....	10,100	.....
April, 1885	.....	.....	.....	6,340	.....
May, 1885	.....	.....	.....	2,300	.....
Total	3,831	129	2,803	46,750	$17,254 12

APPROXIMATE RATE.

46,750 cubic yards, at 37 cents.

NOTE.—This 46,750 cubic yards only includes the amount removed by the dredge and deposited by dump-lighters near the shore. In addition there was a large amount of material moved by the hydraulic process, which was washed away and of which no account is taken in the above estimate. The last bid received for doing this work by contract was at 82½ cents per cubic yard.

Swan Point, under contract.

Date.	Cubic yards of soft mud.	Amount expended.
January, 1885	6,302	.....
February, 1885	15,751	.....
March, 1885	30,020.6	.....
April, 1885	55,387	.....
May, 1885	45,731	.....
Total	153,191.6 at 10.9 cents	$16,697 08

SUMMARY OF WORK DONE BY THE UNITED STATES.

Total number of cubic yards sand and mud	189,931.6
Total number of cubic yards gravel, clay, and decomposed rock	62,221
Total number of cubic yards solid rock	3,325
Total number of bowlders	32
Total number of logs	2
Total number of piles driven	1,310
Total number of linear feet extension and repairs of jetties	1,047
Total number of linear feet brush dike built	6,094
Total number of linear feet holes drilled in rock	1,881
Total number of linear feet holes drilled in clay, Dutch Gap	3,851
Total number of pounds of dynamite used in rock	1,530
Total number of pounds of dynamite used in clay	2,803
Total number of holes fired in rock	168
Total number of holes fired in clay	129
Total number of cords of brush used	3,947

Material moved by private parties.

By whom removed.	Cubic yards.			Number of—		Locality.
	Sand or mud.	Gravel and decomposed rock.	Solid rock.	Bowlders.	Logs.	
City of Richmond	6,050	1,050	10	41	2	Harbor.
Richmond and Danville Railroad	.....	2,300	.....	.....	.....	Wharves at Rocketts.
Richmond and Alleghany Railroad	150	.....	.....	.....	.....	Do.
Chesapeake and Ohio Railway	6,850	.....	.....	.....	5	Almond Creek.
Total	13,050	3,350	10	41	7	

Physical characteristics James River, Virginia, 1884.

Locality.	Area at low tide.	Area at high tide.	Distance of center of area from north side.	Low tide.		Ratio of low-tide area to width.
				Maximum depth.	Width.	
	Sq. feet.	*Sq. feet.*	*Feet.*	*Feet.*	*Feet.*	
Rocklanding Shoal	305, 977	366, 377	15, 641	24. 0	30, 200	10. 13
Tribell Shoal	173, 930	200, 300	6, 237	24. 0	13, 100	13. 27
Goose Hill Flats	172, 955	206, 435	6, 648	17. 0	16, 740	10. 33
Swan Point (line 3)	141, 744	165, 744	7, 047	25. 0	12, 000	11. 81
Dancing Point	124, 392	137, 692	3, 735	26. 0	6, 650	18. 70
Harrison's Bar	68, 521	98, 033	7, 608	22. 5	10, 540	6. 50
Bermuda Hundred	24, 725	31, 430	1, 113	22. 1	1, 800	13. 73
Curle's Neck	18, 350	21, 946	563	21. 0	1, 160	15. 82
Deep Bottom	14, 254	18, 415	654	17. 8	1, 300	10. 96
Varina (Jetty No. 3)	13, 495	16, 415	441	20. 5	885	15. 25
Dutch Gap (below gap)	17, 598	20, 478	346	36. 4	900	19. 55
Dutch Gap (above gap)	12, 790	14, 422	213	39. 5	510	25. 08
Kingsland	8, 927	12, 497	406	18. 4	1, 050	8. 50
Chaffin's Bluff	11, 585	13, 965	276	23. 7	680	17. 04
Drewry's Bluff, obstructions (Jetty 92)	9, 814	11, 914	284	24. 7	600	16. 35
Obstructions to Richmond Bar (Jetty 15)	7, 872	9, 986	336	17. 1	604	13. 03
Richmond Bar, city limits	5, 828	7, 343	237	17. 6	433	13. 46

Physical characteristics James River, Virginia.

JUNE, 1885.

Cross-section.	Area at low tide.	Area at high tide.	Distance of center of area from jetty.	Low tide.		Area at low tide divided by width.
				Maximum depth.	Width.	
	Sq. feet.	*Sq. feet.*		*Feet.*	*Feet.*	
Jetty B to dike	4, 059	5, 319	188	17. 1	360	11. 28
Jetty A to dike	4, 209	5, 539	189	17. 4	380	11. 08
Jetty 1 to dike	4, 400	5, 828	199	17. 1	408	10. 79
Jetty 3 to dike	4, 621	6, 136	208	16. 5	433	10. 67
Jetty 5 to dike	4, 740	6, 105	205	16. 9	390	12. 15
Jetty 7 to dike	4, 887	6, 427	206	16. 7	440	11. 11
Jetty 9 to Chesapeake and Ohio wharves	5, 003	6, 298	205	16. 4	370	13. 52
Jetty 11 to Chesapeake and Ohio wharves	5, 709	7, 144	217	16. 3	410	13. 92
Jetty 13 to Chesapeake and Ohio wharves	6, 023	7, 563	230	16. 2	440	13. 69
Jetty 15 to Chesapeake and Ohio wharves	5, 863	7, 368	233	16. 8	430	13. 63
Jetty 17 to pile	5, 757	7, 447	215	15. 7	483	11. 92
Jetty 19 to 16	5, 586	7, 143	210	17. 0	445	12. 55
Jetty 21 to dike	5, 865	7, 580	222	15. 4	490	11. 97
Jetty 23 to dike	4, 827	6, 472	169	15. 5	470	10. 27
Jetty 25 to dike	5, 358	7, 021	183	16. 6	475	11. 28
Jetty 27 to shore	5, 852	7, 574	210	15. 8	492	11. 89
Jetty 29 to shore	6, 169	8, 139	250	15. 6	563	10. 96
Jetty 31 to shore	6, 425	8, 511	247	15. 9	596	10. 89
Jetty 33 to Jetty 24	6, 570	8, 400	313	18. 8	523	12. 56
Jetty 26 to dike	6, 203	7, 953	194	20. 1	500	12. 41
Jetty 28 to dike	5, 145	6, 720	209	18 4	450	11. 43
Jetty 28½ to dike	4, 840	6, 380	242	16. 2	440	11. 00
Jetty 30 to Jetty 35	5, 110	6, 615	236	15. 7	430	11. 88
Jetty 32 to dike	5, 331	6, 794	233	17. 5	418	12. 75
Jetty 34 to shore	5, 608	7, 085	227	16. 1	422	13. 29
Jetty 36 to shore	5, 774	7, 293	225	16. 5	434	13. 30
Jetty 38 to Jetty 37	6, 091	7, 631	217	16. 3	440	13. 84
Jetty 40 to Jetty 39	5, 968	7, 552	221	16. 3	445	13. 41
Jetty 42 to dike	5, 790	7, 424	250	16. 1	467	12. 40
Jetty 44 to Jetty 41	5, 748	7, 302	235	16. 1	444	12. 95
Jetty 46 to dike	5, 757	7, 384	257	15. 2	465	12. 38
Jetty 46½ to Jetty 43	5, 789	7, 329	234	15. 9	440	13. 16
Dike to 43½	5, 864	7, 383	234	16. 6	434	13. 51
Jetty 45 to shore	6, 233	7, 853	228	17. 9	463	13. 46
Jetty 47 to Jetty 48	6, 201	7, 650	211	17. 5	414	14. 98
Jetty 49 to Jetty 50	6, 233	7, 668	207	17. 7	410	15. 20
Jetty 51 to Jetty 52	6, 368	7, 838	213	17. 8	420	15. 16

Physical characteristics James River, Virginia—Continued.

JUNE, 1885—Continued.

Cross-section.	Area at low tide.	Area at high tide.	Distance of center of area from jetty.	Low tide.		Area at low tide divided by width.
				Maximum depth.	Width.	
	Sq. feet.	*Sq. feet.*		*Feet.*	*Feet.*	
Jetty 53 to Jetty 54	6,158	7,698	220	18.7	440	14.00
Jetty 55 to Jetty 56	6,473	8,083	231	17.7	460	14.07
Jetty 57 to Jetty 58	6,732	8,377	226	17.3	470	14.32
Jetty 59 to Jetty 60	6,742	8,422	221	19.0	480	14.05
Jetty 61 to Jetty 62	6,688	8,424	239	16.8	496	13.48
Jetty 63 to Jetty 64	6,509	8,241	230	17.7	495	13.15
Jetty 65 to Jetty 66	6,414	8,199	232	16.3	510	12.56
Jetty 67 to Jetty 68	6,522	8,342	251	18.5	520	12.54
Jetty 69 to Jetty 70	6,675	8,516	253	18.4	526	12.69
Jetty 72 to shore	6,914	9,014	274	15.3	600	11.52
Jetty 74 to shore	7,157	9,197	290	19.9	583	12.28
Jetty 76 to shore	7,067	9,034	287	15.1	562	12.58
Jetty 78 to shore	7,533	9,500	294	15.4	562	13.40
Jetty 80 to shore	7,477	9,468	302	15.1	569	13.14
Jetty 82 to Jetty 84	7,774	9,699	296	18.7	550	14.13
Jetty 84 to Jetty 83	7,855	9,794	285	17.9	554	14.18
Jetty 86 to Jetty 85	7,865	9,842	303	17.4	565	13.82
Jetty 88 to Jetty 87	8,037	10,081	315	18.1	584	13.76
Jetty 90 to Jetty 89	7,911	9,976	316	16.6	590	13.41
Jetty 92 to Jetty 91	8,025	10,125	328	16.6	600	13.37
Jetty 94 to shore	8,178	10,593	418	17.3	690	11.85
Jetty 96 to shore	8,335	10,627	393	19.0	655	12.73

Table showing freshets in the James River, Virginia, and the heights to which they rose at Richmond.

Date.	Height above mean low water.	Date.	Height above mean low water.	Date.	Height above mean low water.
	Feet.		*Feet.*		*Feet.*
Unknown	13.30	November 25, 1877	28.62	February 13, 1881	12.95
Unknown	13.05	January 15, 1878	8.85	December 27, 1881	10.50
Unknown	12.65	February 11, 1878	7.30	February 11, 1882	11.00
1847	16.50	April 11, 1878	5.50	January 21, 1883	9.70
1863	16.79	May 7, 1878	6.26	April 18, 1883	9.70
1864 (?)	16.10	May 16, 1878	6.30	April 26, 1883	8.80
October 1, 1870	27.02	September 15, 1878	13.38	January 7, 1884	7.70
February 26, 1875	14.38	November 18, 1878	12.75	February 11, 1884	10.50
December 9, 1875	5.60	December 12, 1878	12.62	March 11, 1884	13.70
March 30, 1876	12.00	January 16, 1879	7.80	March 27, 1884	15.70
September 24, 1876	12.19	December 15, 1879	9.82	June 15, 1884	8.40
January 17, 1877	10.50	February 15, 1880	6.76	June 28, 1884	9.30
April 10, 1877	6.90	March 15, 1880	13.32	May 28, 1885	9.90
October 5, 1877	13.83	May 2, 1880	6.90		
November 9, 1877	11.00	January 22, 1881	10.40		

COMMERCIAL STATISTICS, 1884.

Exports:	
Flour	$1,353,217
Cotton	1,123,000
Miscellaneous	121,626
Total	2,597,843

Imports, free of duty:	
Coffee	$197,055
Guano	21,777
Miscellaneous	3,913
Total	222,745
Imports on which duty was paid:	
Salt	4,685
Molasses	7,126
Miscellaneous	3,795
Total	15,606

Number of vessels arriving in the port of Richmond.

Description.	Entered.		Cleared.	
	Number.	Tonnage.	Number.	Tonnage.
Vessels engaged in the foreign trade	28	8,440	72	19,255
Vessels engaged in the coastwise trade	584	410,665	570	405,829

HARBOR-MASTER'S STATEMENT.

Whole number of vessels arriving in the port of Richmond.

Sea-going steamers	340
Barks	24
Brigs	36
Schooners	552

NOTE.—This list does not include river steamers, tug-boats, or small sailing-vessels that trade in Virginia waters.

J 4.

IMPROVEMENT OF SHENANDOAH RIVER, WEST VIRGINIA.

The river and harbor act approved June 14, 1880, contains an item appropriating $1,500 for improving the Shenandoah River, West Virginia. The act approved March 3, 1881, contains one item appropriating $2,500 for improving the same river, and provides that neither of these appropriations shall be expended "until any corporate rights or franchises that may exist over said river shall have been relinquished to the United States to the satisfaction of the Secretary of War."

The proviso was adopted, apparently, because the Shenandoah River Navigation Company, organized under a charter from the State of West Virginia for improving the river, had certain corporate rights and privileges, among which was the right to collect tolls.

The charge of the work was turned over to me July 29, 1884, prior to which date it had been under charge of Lieut. Col. William P. Craighill, Corps of Engineers, U. S. Army.

Colonel Craighill submitted a project for the improvement July 9, 1880. He proposed to put the river, or rather that portion of it in West Virginia, practically in the same condition that it was before the freshet of 1877, by repairing and rebuilding where necessary the locks, dams, and chutes from Little's Falls to Harper's Ferry; giving over

this portion of it a down-stream navigation for flat-boats drawing not more than 18 inches of water.

The locks, chutes, and dams referred to were the property of the Shenandoah River Navigation Company. On May 9, 1882, the stockholders of this company held a meeting and passed resolutions relinquishing in favor of the United States "all the rights, interests, property, franchises, stock, or appurtenances," * * * "and all works, improvements, constructions, dams, locks," and virtually disbanded and dissolved. On February 20, 1883, the legislature of West Virginia confirmed the action of the Shenandoah River Navigation Company.

By indorsement dated July 21, 1883, on a letter from the Department of Justice, dated July 2, 1883, the Hon. Secretary of War states that he is "satisfied that the rights or franchises referred to in the act of March 3, 1881, have been relinquished to the United States."

In order to comply with section 355, Revised Statutes of the United States, relative to the expenditure of money on sites purchased by the Government for public buildings, &c., the Secretary of War, on July 24, 1883, asked the Attorney-General of the United States to request the United States attorney for the district of West Virginia "to submit an abstract of the titles to the sites occupied by the works of the navigation company."

These abstracts, transmitted to me by the Chief of Engineers, U. S. Army, on January 7, 1885, show that the works of this company have been located on land owned by private parties, as none was ever purchased for the sites of locks, &c. The district attorney informs me that "no conveyance to or written contract with them or either of them was recorded in the county of Jefferson, where the improvements were, or is now known to have been made." It therefore appears that "when the navigation company transferred its rights, privileges, &c., it transferred no real estate."

The first thing now necessary in undertaking this work of improvement is to acquire title to the sites for the locks, &c. This can be done in most cases, perhaps, by purchase from the owners, or by condemnation in accordance with the provisions of river and harbor acts making appropriations for the Shenandoah River.

A good description of the river will be found in the report of N. H. Hutton, assistant engineer, dated December 15, 1879, and published in the Annual Report of the Chief of Engineers, U. S. Army, for 1880, Appendix G. From this report it will be seen that to improve any short section of the river will be of little benefit to it as a whole, the depth over the ledges to which Mr. Hutton refers, of which there are great numbers, being only from 4 to 9 inches in the deepest parts.

Colonel Craighill, in his report dated January 5, 1880, states that—

> All these reports [referring to Hutton's, Fisk's, and Herron's] indicate the very considerable expense of an attempt to slack water or highly improve the navigation of Shenandoah River. Its present importance as a route for moving freight is not sufficient to justify the expenditure of a large sum upon it. This is particularly true, since, in addition to the existing Valley Branch of the Baltimore and Ohio Railway the construction of the Shenandoah Valley Railway [since completed] seems an assured fact.

At the present time there is no commerce on the river, at least on that portion of it in West Virginia, and there has been none since 1877. There are two lines of railroad running parallel to it, and almost along its very banks. If the money must be spent the best thing to do will be to restore to the portion of the river to which the appropriation is applicable the 18-inch down-stream navigation that existed prior to

the freshet of 1877, by repairing the locks, chutes, and dams of the navigation company. But it is doubtful whether the public interests require it. Moreover, it must be remembered that the expense to the Government is not limited to the first cost of making the improvement. Locks will have to be operated and kept in working order; and chutes and dams repaired as occasion requires. These will necessitate an annual expenditure hereafter. Not less than four locks will be required, and if we put the annual cost of operating each at the low figure $500, and the annual cost of repairs to the dams and chutes at $1,000 there will be needed $3,000 annually to render the improvement effective.

The question is now raised by the Solicitor of the Treasury. Can the Government properly carry this improvement into effect, in view of the recent sale of its property at Harper's Ferry. By the terms of this sale, made in accordance with the act of Congress approved July 4, 1884, the Government has parted with the identical property it needs to make the improvement. The Solicitor states that by the terms of the sale as well as by the law, "the purchaser is entitled to the entire water-power of the Shenandoah as held by the United States," and among the incidents to those privileges, it may be claimed, is the right to erect and maintain dams, to open or widen water-ways, and in fact to adopt all means necessary to supply a certain volume of water;" and the question arises, is it practicable now to make the improvements without infringing on the riparian and other rights guaranteed the purchaser? If the sale operates as a bar to recovering the property, or at least a portion of it, then the improvement cannot be made. But if the owner is willing to concede to the United States the right to use such water as may be necessary, and to sell back to the United States the sites of the old locks, the improvement can be made.

The act authorizing and directing the sale of the property was subsequent to the acts making the appropriations. Did Congress have in view the previous acts when the later one was passed? It seems hardly probable that it was intended to sell the identical property needed in the proposed improvement.

In view of the above facts, it seems that further legislation is advisable.

Money statement.

July 1, 1884, amount available	$17,306 20
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	1,222 80
July 1, 1885, amount available	16,083 40

APPENDIX K.

IMPROVEMENT OF THE HARBORS AT BRETON BAY AND SAINT JEROME'S CREEK, MARYLAND; OF THE CHANNEL AT MOUNT VERNON; OF RAPPAHANNOCK RIVER; AND YORK RIVER, VIRGINIA; OF TRIBUTARIES OF THE LOWER POTOMAC, AND OF CERTAIN RIVERS IN VIRGINIA AND NORTH CAROLINA.

REPORT OF MR. S. T. ABERT, UNITED STATES AGENT, IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1885, *WITH OTHER DOCUMENTS RELATING TO THE WORKS.*

IMPROVEMENTS.

1. Channel at Mount Vernon, Virginia.
2. Neabsco Creek, Virginia.
3. Breton Bay, Leonardtown, Md.
4. Nomini Creek, Virginia.
5. Harbor at entrance of Saint Jerome's Creek, Maryland.
6. Rappahannock River, Virginia.
7. Totusky River, Virginia.
8. Urbana Creek, Virginia.
9. Mattaponi River, Virginia.
10. Pamunky River, Virginia.
11. York River, Virginia.
12. Chickahominy River, Virginia.
13. } Staunton River, Virginia.
14. }
15. Dan River, between Madison, N. C., and Danville, Va.
16. Roanoke River, North Carolina.
17. French Broad River, North Carolina.

EXAMINATIONS AND SURVEYS.

18. Cockpit Point, Virginia, for ice-harbor.
19. Colonial Beach, formerly White Point, in county of Westmoreland, Virginia.

UNITED STATES ENGINEER OFFICE,
Washington, D. C., July 27, 1885.

GENERAL: I have the honor to submit herewith my annual report for the fiscal year ending June 30, 1885, relating to the improvement of rivers and harbors under my charge.

Very respectfully, your obedient servant,

S. T. ABERT,
United States Agent.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

K 1.

IMPROVEMENT OF POTOMAC RIVER AT MOUNT VERNON, VIRGINIA.

HISTORY OF OPERATIONS.

(1) *Reference to reports.*—A history of operations will be found in the Report of the Chief of Engineers for the year 1882, page 1003.

(2) *Description of original condition.*—The landing at the wharf was formerly made by passing over the flat bordering the channel of the Potomac for a distance of 1,900 feet. The least depth of water at that line was 4 feet at low water.

(3) *Plan of improvement.*—The proposed cut to the wharf was intended to have a width of 150 feet and a navigable depth of 6 to 7 feet, with a basin at the wharf of 150 feet radius.

(4) *Results obtained.*—The channel was completed September 1, 1881, with a width of 145 feet and a depth of from 7 to 9 feet, and although the cut was made across the tidal current, but little filling has occurred since that date.

Forty-one thousand three hundred and eighty-four cubic yards of material were removed in 1880 and 1881, at rates varying from 12½ to 17 cents per cubic yard.

(5) *Operations proposed.*—Five thousand five hundred dollars will be required for the purpose of enlarging the basin, widening the channel, and for removing the silt which has been deposited in the cut.

The following appropriations have been made:

March 3, 1879	$4,000
June 14, 1880	3,000
March 3, 1881	1,500
Total	8,500

Money statement.

July 1, 1884, amount available	$57 14
July 1, 1885, amount available	57 14
Amount (estimated) required for completion of existing project	5,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	5,500 00
Submitted in compliance with requirements of section 2 of river and bor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

No statement of the trade of the past year has been received. The valve of shipments for the year 1882 was about $12,000. The steamer W. W. Corcoran makes daily trips to Mount Vernon, Sundays excepted, carrying a large number of visitors.

K 2.

IMPROVEMENT OF NEABSCO CREEK, VIRGINIA.

HISTORY OF OPERATIONS.

(1) *Reference to reports.*—The report of the survey will be found in the Report of the Chief of Engineers for 1881, page 947. For history of operations see page 1006, Report of Chief of Engineers for the year 1882, Part I.

(2) *Description of original condition.*—Neabsco Creek, situated in Prince William County, Virginia, is a tributary of the Potomac River, which it enters at the lower end of Occoquan Bay, on the Virginia shore, about 28 miles below Washington, D. C. Its width at the mouth is about 2,500 feet. The width contracts to 1,250 feet at Willis's Landing, 7,500 feet from the 7-foot curve; at 8,300 feet from the same curve the width contracts to about 40 feet, and continues at nearly the same width for a distance of 6,470 feet, or for 14,770 feet from the 7-foot curve in the river. Taking these sections of the channel in the same order, the distance from the 7-foot curve to the draw of the Alexandria and Fredericksburg Railroad is 6,450 feet, and the least depth at low water is 3.5 feet. From the draw to Willis's Landing the distance is 1,050 feet, and the least depth is 2.5 feet. From Willis's Landing for a distance of 800 feet the least depth is 2 feet; from there to Atkinson's Landing, the head of barge navigation, the distance is 6,470 feet, or 14,770 feet from the 7-foot curve in the river; the least depth is 3.5 feet.

(3) *Plan of improvement.*—According to the original project of improvement, the channel was to be 100 feet wide and 7 feet deep at low water.

(4) *Amount expended and results obtained.*—The channel was completed to a width of 50 feet and a depth of 4 to 5 feet at low water. The cut extends from the 4-foot curve in the Potomac River to the narrow part of the creek, where a sufficient depth of water exists, a distance of 5,800 feet. Five thousand dollars have been expended in removing 23,613 cubic yards of material from the channel, at the rate of 15¾ cents per cubic yard.

The following appropriation has been made:

March 3, 1881	$5,000

For the fiscal year ending June 30, 1887, an appropriation of $20,000 is recommended if Congress desires to continue the improvement.

The work is in the collection district of Alexandria, which is the nearest port of entry. The nearest light-house is at Fort Washington. The collections during the fiscal year ended June 30, 1882, were $2,695.63.

Money statement.

July 1, 1884, amount available	$57 27
July 1, 1885, amount available	57 27
Amount (estimated) required for completion of existing project	20,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	20,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

STATISTICS OF TRADE.

According to Mr. M. A. Ish the following shipments were made during the year 1884:

Firewood, cords	800
Railroad ties	5,000
Piles	1,000
Sawed lumber, feet, B. M	75,000
Groceries, fertilizers, &c	$10,000
The value of shipments for 1882 was about	$31,000

K 3.

IMPROVEMENT OF BRETON BAY, LEONARDTOWN, MARYLAND.

HISTORY OF OPERATIONS.

(1) *Reference to reports.*—A history of operations will be found in the Report of the Chief of Engineers for the year 1882, page 1009, and in the Report for the year 1883, page 797.

(2) *Description of original condition.*—Breton Bay enters the Potomac River 82 miles below Washington, D. C. For a distance of 3,600 feet its general course from Leonardtown is southeast, where it changes to southwest, and terminates at a distance of 6¼ miles from the town at the 18-foot curve in the Potomac. Its width at Leonardtown is about 850 feet; 1¼ miles below the width is 1,550 feet, and after further widening it contracts at the mouth to about 1 mile. Its least depth is 8.8 feet near Leonardtown, which gradually increases to 18 feet at the mouth. Before improvement the bar extended from Leonardtown to the 9-foot curve in the bay, a distance of about 1 mile. The least depth on it at low water was 5 feet.

(3) *Plan of improvement.*—The original project contemplated dredging a channel 150 feet wide and 9 feet deep from Leonardtown to the 9-foot curve. A basin was to be dredged at the Leonardtown Wharf.

(4) *Results obtained.*—The channel is now 115 feet wide, and not less than 8.8 feet deep. It was found after examination that the basin had decreased in depth at the upper end, and that the channel below the wharf had also decreased in depth for a distance of 2,800 feet. The decreased depth of the basin and of the channel below does not seem to have the same cause. The basin appears to have been filled by the wash from the creeks and banks above it, while the channel below seems to have been much injured by the injudicious management of the steamers. Both these effects may be reduced, but it seems impossible to remove the cause.

WORK DURING THE FISCAL YEAR ENDING JUNE 30, 1885.

The following is an abstract of the bids opened November 20, 1884:

No.	Name and address.	Time of commencement.	Time of completion.	Price per cubic yard.	Remarks.
				Cents.	
1	Thomas P. Morgan, Washington, D. C.	Dec. 1, 1884...	June 30, 1885..	12	One dredge. Daily average, 500 yards.
2	Henry Birch, Washington, D. C.	Dec. 1, 1884 ..	June 1, 1885...	16	One Osgood dredge.
3	James Caler & Son, Norfolk, Va,	.....	June 1, 1885...	13½	One good dipper dredge. Daily average, 700 yards.
4	National Dredging Company, Wilmington, Del.	.....	March 1, 1885..	13	Requisite machinery.
5	Baltimore Dredging Company, Baltimore, Md.	March 1, 1885..	June 1, 1885...	17	
6	P. Sanford Ross, Jersey City, N. J.	Dec. 1, 1884...	.....	16¾	Suitable dredging plant.

The contract was awarded to Thomas P. Morgan, the lowest bidder, at 12 cents per cubic yard. Work commenced December 13, 1884, and was completed January 29, 1885, during which time 20,359 cubic yards of material were dredged from the basin and from the channel between Leonardtown and the turn.

To prevent the effect of filling it was proposed to deposit the excavation in lines parallel with the cut and to the level of low water, at a

distance of 360 feet upon each side of the channel. Lateral channels were to be left where needed for drainage or navigation. This operation was stopped at the desire of the citizens, and the effort to create a current for preserving the depth in the channel was, in consequence, defeated.

(5) *Amended project.*—In order to maintain the depth of water in the channel, I would propose to widen the cut to 200 feet and for a distance of 1½ miles; and to enlarge the basin to a width of 400 feet by 800 in length. So far as it may be permitted, I would deposit the material parallel with the channel, as above described. The basin and the channel should not be less than 10 feet in depth.

The following are the items of the estimate:

143,000 cubic yards, at 15 cents per cubic yard	$21,450
20 per cent. for contingencies	4,290
	25,740

This work can be completed for the sum of $26,000 if appropriated in one or two years.

(7) *Amount expended.*—Between the years 1879 and March, 1885, $23,000 have been expended in excavating 131,358 cubic yards of material at rates varying from 12 to 18 cents per cubic yard.

The following appropriations have been made:

June 18, 1878	$5,000
March 3, 1879	4,000
June 14, 1880	3,000
March 3, 1881	3,000
August 2, 1882	5,000
July 5, 1884	3,000
Total	23,000

The work is in the collection district of Annapolis, which is the nearest port of entry. The collections for the year ended June 30, 1882, were $1,009.23. The work is in the Fifth Light-House District, and the nearest ilght-house is Blakistone Island Light.

Money statement.

Amount appropriated by act approved July 5, 1884	$3,000	00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	2,952	16
July 1, 1885, amount available	47	84
Amount (estimated) required for completion of existing project	26,000	00
Amount that can be profitably expended in fiscal year ending June 30, 1887	26,000	00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867		

Statistics of trade for 1884, *furnished by Mr. H. F. Moore.*

Natural products.

Articles.	Value.	Articles.	Value.
Bacon and hogs	$44,000	Iron (bar, pig, and scrap)	$1,000
Beef and other cattle	10,000	Lard	3,500
Bark	1,000	Lumber and logs	64,000
Coal	8,000	Peanuts, peas, and beans	1,500
Eggs and poultry	12,000	Potatoes	1,500
Fish and oysters	10,000	Railroad ties	50,000
Fruits (green and dried)	500	Sheep and lambs	20,000
Furs	1,500	Staves and barrel timber	2,000
Grain	25,000	Tobacco	25,000
Horses and mules	1,000	Wood	35,000
Hoop poles	6,000	Wool	2,000
Hay	5,000		
Hides	1,500	Total	331,000

Manufactures for 1884.

Articles.	Value.	Articles.	Value.
Agricultural machines and implements	$35,000	Liquors	$75,000
Castings	5,000	Mill machinery	5,000
Corn meal	5,000	Machinery (other than agricultural and mill)	1,000
Drugs and chemicals	10,000	Mill feed	5,000
Fertilizers	50,000	Wagons, carriages, &c	2,000
Flour	10,000	Woven fabrics	50,000
Furniture	5,000	Boots, shoes, hats, and caps	40,000
Groceries	40,000		
Hardware	10,000		
Leather	5,000	Total	353,000

K 4.

IMPROVEMENT AT NOMINI CREEK, VIRGINIA.

HISTORY OF OPERATIONS.

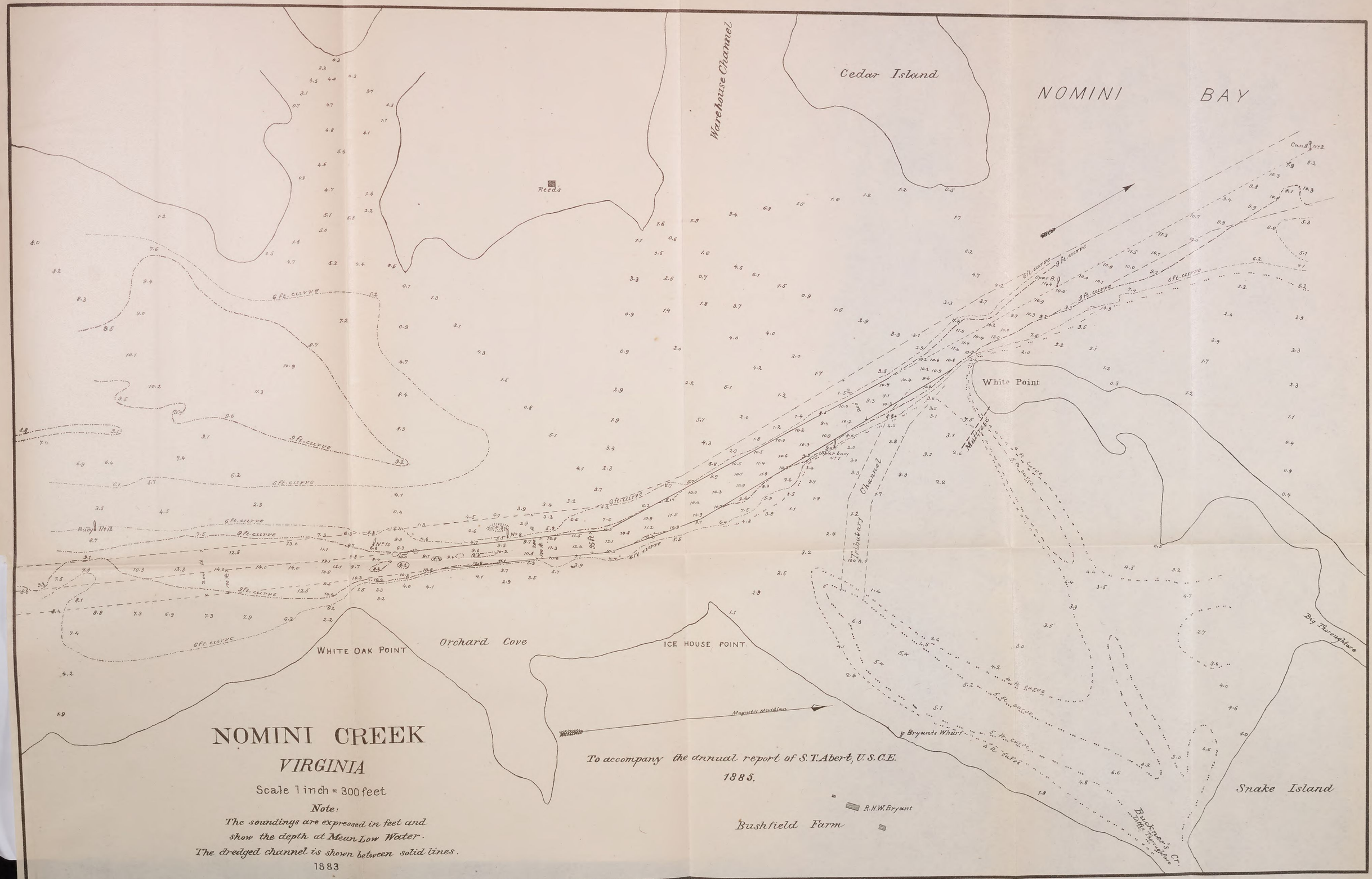
(1) *Reference to reports.*—The report of the final survey will be found in the Report of the Chief of Engineers for 1873, page 822. The report of survey from the ferry (Nomini Wharf) to the head of tide-water at Beale's Mill will be found in the Report for 1881, page 954. For history of operations to June 30, 1884, see Reports from 1882 to 1884.

(2) *Description of creek before improvement.*—Nomini Creek is a tributary of the Potomac, which it enters about 82 miles below Washington, D. C. Its general course through Westmoreland County is southeast. The landing at Nomini Ferry, about 3 miles above the mouth, is reached after passing a bar, which had, before improvement, but 3 feet of water upon it at low water. Between the head of the bar and the ferry, the depth was ample, being from 9 to 12 or more feet. The length of the bar from White Point to Hickory Point, at the upper end, was 4,100 feet. From the mouth to the 9-foot curve in Nomini Bay in the Potomac the distance was 1,600 feet.

Vessels drawing 5 feet of water can proceed for a distance of $1\frac{1}{2}$ miles above the ferry. Barges can navigate to a bridge near Beale's Mill, which is about $2\frac{1}{4}$ miles from the same point.

(3) *Plan of improvement.*—The improvement proposed in the original project was to dredge a channel 100 feet wide and 9 feet deep at low water, from the 9-foot curve in Nomini Bay to White Oak Point, a distance of 4,400 feet. The large increase of trade which followed the opening of the new channel called for an amended project, which was submitted in 1882. The amendment consisted in the proposed widening of the main channel, and in cutting a tributary channel from Bushfield Bay (on the right) in an oblique direction to the main channel. As supplementary to this cut, the closing of the old channel for the same bay was proposed. The old side channel is objectionable for two reasons: It causes the extension of White Point, which encroaches more each year upon the main channel, and it conducts a strong ebb current, which impinges on the bows of the entering steamers and forces them into the shoal water on the opposite side. The widening of the main channel is necessary for the safe navigation of the steamers from Baltimore and Washington. The total cost of the project, original and amended, was $62,500.

The suspension of the work for two years and its slow execution have increased the contingent expenses. Steamers have grounded on the



NOMINI CREEK

VIRGINIA

Scale 1 inch = 300 feet

Note:

The soundings are expressed in feet and show the depth at Mean Low Water.

The dredged channel is shown between solid lines.

1883

To accompany the annual report of S.T.Abert, U.S.C.E.

1885.

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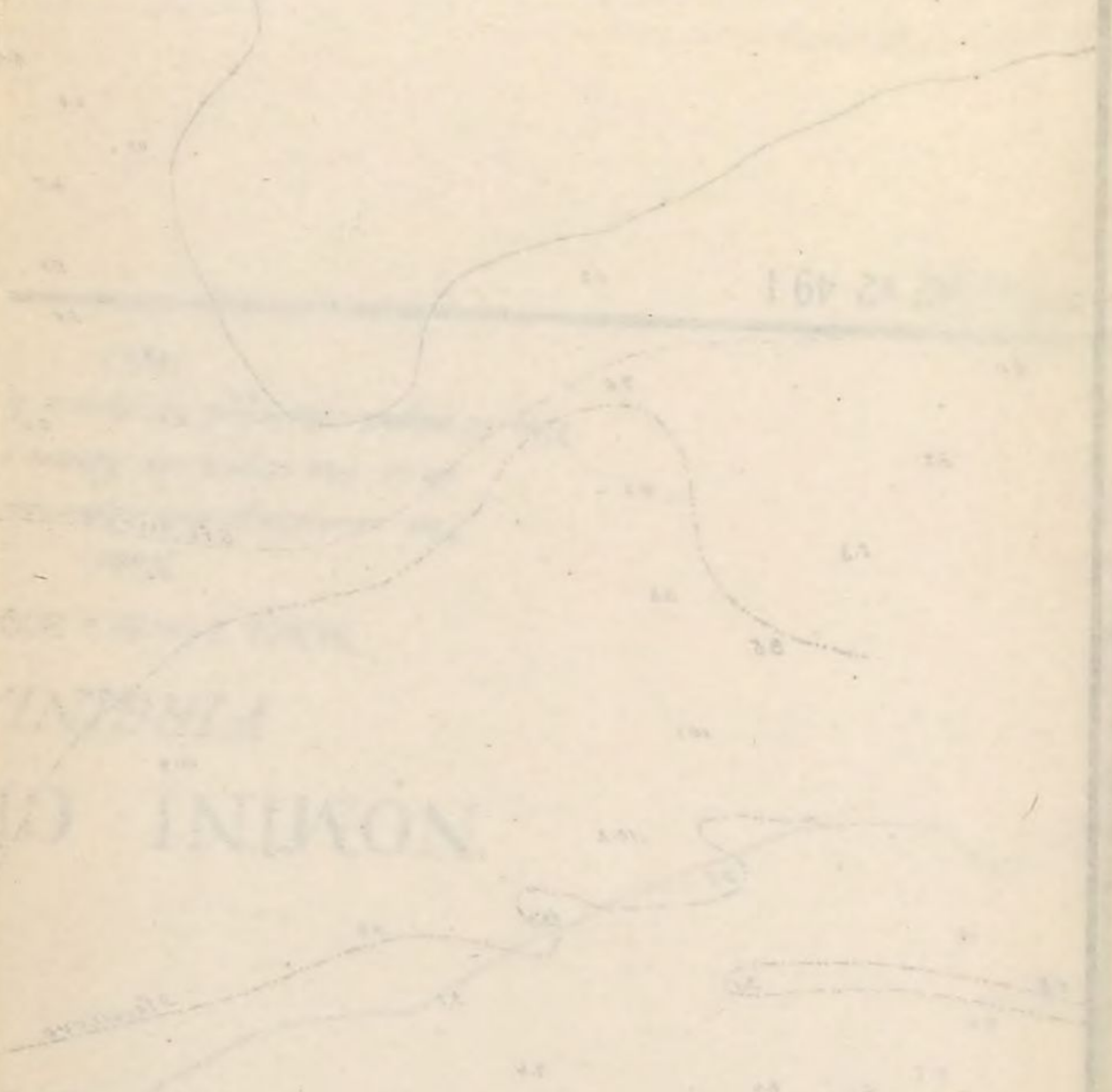


shallows bounding the main channel and have reduced its depth. I assume that the work has been increased about $4,000 more from these causes.

The total for the work would therefore be	$62,500
The amount expended has been	32,500
Amount to be expended	30,000

This sum, if granted in one or even two appropriations, would make a satisfactory channel to Nomini Ferry of a width of 200 feet, and a depth, at low water, of not less than 9 feet.

In 1881 an estimate was submitted for extending the work from Prospect Wharf, 1½ miles above Nomini Ferry, to Davis's White Point, and thence to the bridge on the Warsaw road, a distance of a little more than 2¼ miles. The amount of the estimate was $52,000. No project was submitted for the work, which was regarded as secondary to the work to be done between Hickory Point and Nomini Bay.

(4) *Results obtained.*—Thirty-two thousand five hundred dollars have been expended in dredging 74,874 cubic yards of sand and shells, which has resulted in securing a channel about 100 feet wide and 9 feet deep from the 9-foot curve in Nomini Bay to White Oak Point, a distance of 4,400 feet. Steamers now trade where formerly only small vessels drawing about 3 feet of water could reach at high tide.

(5) *Work done during the fiscal year ending June* 30, 1885.—No appropriations were made for work during this year.

(6) *Work proposed for the fiscal year ending June* 30, 1887.—It is proposed to complete the work according to the project submitted in 1882 and described above, namely, to widen the cut to 200 feet for a distance of 5,700 feet from the 9-foot curve in Nomini Bay to Hickory Point.

The following appropriations have been made:

March 3, 1873	$10,000
June 2, 1874	6,000
March 3, 1875	5,000
March 3, 1879	2,500
June 14, 1880	5,000
March 3, 1881	2,000
August 2, 1882	2,000
Total	32,500

The work is in the collection district of Tappahannock, which is the nearest port of entry. The collections for the year ending June 30, 1882, were $1,451.

A chart of Nomini Creek and part of the Nomini Bay accompanies this report.

Money statement.

Amount (estimated) required for completion of existing project	$30,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	30,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

STATISTICS OF TRADE FOR 1884.

Mr. C. W. Ridley makes the following report:

The principal shipments by steamer are oysters, fish, poultry, eggs, live-stock, fruit, berries, and grain. From actual accounts and careful estimates, the trade to and from Nomini Creek by steamers alone for the year ending December 31, 1884, is placed at $291,557.

There are three steamers engaged in the trade (tonnage about 1,590), making eight trips to and from Nomini Creek per week. The greatest draught of these steamers is 7 feet.

Mr. F. E. Tubman reports the following shipments by sailing vessels:

Articles.	Value.	Articles.	Value.
Clover seed	$1,000	Ties	$1,600
Corn	1,500	Wheat	2,000
Lumber (sawed)	750	Wood, pine	5,000
Oysters	1,500	Wood, poplar	9,750
Phosphate	2,250		
Posts, cedar and locust	250	Total	25,660
Staves, oak	60		

K 5.

IMPROVEMENT OF HARBOR AT ENTRANCE TO SAINT JEROME'S CREEK, MARYLAND.

HISTORY OF OPERATIONS.

(1) *Reference to reports.*—A report and estimate will be found in the Report of the Chief of Engineers for 1881, Part I, page 935. The Reports of 1881, 1882, 1883, 1884, and 1885 give the work done since that date.

(2) *Original condition.*—Saint Jerome's Creek lies wholly in Saint Mary's County, Maryland, and enters Chesapeake Bay 6 miles north of Point Lookout and 91 miles south of Baltimore. It is formed by two prongs or branches, a south prong and a north prong. The latter has a depth varying from 6 to 15 feet for a distance of about 1½ miles. The average depth in the small channel, which connects the ponds used by the Fish Commission for experiments in hatching oysters, was, before improvement, about one-half a foot at low water. A bar at the mouth, between the 9-foot curve in the bay and Corsey's Point, has a length of 2,193 feet, and a minimum depth of 2.8 feet at low water. The banks are low; the land is level and sandy.

The nearest harbors of refuge are the Patuxent River to the north, and Saint Mary's River, in the Potomac, about 30 miles distant. From its situation it is evident that Saint Jerome's would afford a convenient harbor of refuge, particularly for small sailing vessels and oyster-boats, if the bar at the mouth were removed.

(3) *Plan of improvement.*—The original project contemplated dredging a continuous channel through the bar and into the south prong as far as the "Hatching Pond." For convenience of description, this channel was divided into an outer and an inner channel, the dividing line being at the mouth of the creek.

First. The outer channel was to be dredged to a width of 100 feet, a length of 2,193 feet, and a depth of 9 feet at low water.

Second. The inner channel was to be dredged to a width of 40 feet, a length of 3,742 feet from Corsey's Point to the wharf of the Fish Commission, and a depth of 6 feet at low water.

(4) *Amount expended and results obtained.*—The cost of the work up to June 30, 1884, was $11,500.

The inner channel has been dredged to a depth varying from 3.7 to 6 feet at low water. Its width is about 30 feet.

The outer channel is now in progress.

The least depth at the close of the fiscal year June 30, 1884, was 3.8 feet at low water.

The work, particularly on the bar, has always been regarded as experimental. The preservation of the depth is doubtful, for reasons which have been stated in former reports.

The effect of the cut between the ponds will be to enlarge the tidal reservoir, and the increased outflow will tend to preserve the depth upon the bar.

If this work is successful, Saint Jerome's Creek will become an important harbor of refuge.

(5) *Work done during the fiscal year ending June* 30, 1885.—All work on this creek is done by dredging under contract.

The following is an abstract of the bids opened November 20, 1884:

No.	Name.	Price per cubic yard.	Time of commencement.	Time of completion.	Remarks.
		Cents.			
1	James Caler & Son, Norfolk, Va.	13	.....	June 1, 1885...	One good dipper-dredge.
2	National Dredging Company, Wilmington, Del.	21	.....	.....	
3	Henry Birch, Washington, D. C.	30	Dec. 1, 1884...	June 1, 1885...	One Osgood dipper-dredge.
4	Baltimore Dredging Company, Baltimore. Md.	23	Jan. 1, 1885 ...	June 1, 1885...	One or more dipper-dredges.
5	Morris & Cumings Dredging Company, New York City.	20	.....	June 30, 1885..	
6	Richard M. Payn, Albany, N. Y.	$22\frac{9}{10}$	.....	.....	
7	P. Sanford Ross, Jersey City, N. J.	$24\frac{3}{4}$	Dec. 1, 1884...	.....	

The contract was assigned to James Caler & Son, of Norfolk, Va., the lowest bidder, at 13 cents per cubic yard. It was entered into December 18, 1884, and approved by the Chief of Engineers January 9, 1885. The dredging was begun February 2, 1885; 51,954 cubic yards were dredged up to the close of the fiscal year ending June 30, 1885. The greatest number of cubic yards dredged per day was 824, the least was 124.

The material taken from the cut between the 9-foot curve in the bay and Deep Point varied as follows:

Between the 9-foot curve and Buoy No. 4, about one-third of the distance to Corsey's Point, the material is hard sand; from this point (Buoy No. 4) to Station 8, in the curve, which is about 500 feet inside of Corsey's Point, the material is principally soft mud; from the last point to 100 feet outside of Deep Point the material is composed of sand, clay, and gravel.

Not quite one-half of the material to be removed has been dredged. The work will be completed in the early part of the fiscal year ending June 30, 1886.

The relation of the work done to the whole project may be considered under the following heads, viz, the inner channel and the outer channel.

(1) *The inner channel.*—The project proposed a width of 40 feet and a depth of 6 feet at low water.

(2) *The outer channel.*—The project proposed a width of 100 feet and a depth of 9 feet at low water. The outer channel has been completed with the prescribed width and with a minimum depth of 8 feet at low water.

Some irregularities which exist will be removed before the contract is completed.

Before the improvement the depth of water on this bar was 2.8 feet.

The inner channel has been dredged to a minimum depth of 3.7 feet at low water; its present width is 30 feet. This is a little more than one-half of the depth and three-fourths of the width proposed in the project.

The inner channel will require an additional appropriation to make the depth and width desired by the Fish Commission, viz, a width of 40 feet at bottom and a depth of 6 feet at low water. To continue the excavation to the above dimensions will cost about $26,000.

If about $18,000 are expended in one season the channel will then be 20 feet wide at bottom and 6 feet deep at low water.

The expenditure of $8,000 more the following season will complete the work desired by the Fish Commission.

This appropriation is expressly asked in the interest and at the desire of the Fish Commission. It is but fair, however, to state that every cubic yard removed is equally in favor of the object of making Saint Jerome's Creek a harbor of refuge. Every cubic yard removed from the inner channel will increase the tidal reservoir in proportion to the amount of removal. It will also increase the tidal current, which can alone keep an open channel over the outer bar.

The following appropriations have been made:

March 3, 1881	$6,500
August 2, 1882	5,000
July 5, 1884	15,000
Total	26,500

The work is in the collection district of Annapolis. The nearest light-house is Point Lookout, 6 miles distant.

Money statement.

July 1, 1884, amount available		$54 07
Amount appropriated by act approved July 5, 1884		15,000 00
		15,054 07
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$6,601 52	
July 1, 1885, outstanding liabilities	2,241 92	
		8,843 44
July 1, 1885, amount available		6,210 63
Amount (estimated) required for completion of existing project		26,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		18,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

Statistics of trade for 1884, *furnished by Mr. G. G. Joynes.*

Natural products.

Articles.	Total value of shipments and receipts.	Articles.	Total value of shipments and receipts.
Beef and other cattle	$5,000	Potatoes	$3,000
Eggs	600	Poultry	2,000
Fish and oysters	75,000	Sheep and lambs	4,000
Fruits (green and dried)	3,000	Tobacco	15,000
Grain	50,000	Wood	5,000
Hogs	400	Wool	2,500
Hides	500		
Logs	1,800	Total trade by water	167,800

K 6.

IMPROVEMENT OF THE RAPPAHANNOCK RIVER, VIRGINIA.

HISTORY OF OPERATIONS.

(1) *Reference to reports.*—A summary of operations from the commencement of the work to the end of the fiscal year closing June 30, 1882, will be found in the Report of the Chief of Engineers for that year, page 1017; also in the Report for 1883, page 802. The Report of the survey of Capt. Joseph F. K. Mansfield, made in 1852, will be found in the report of the Chief of Engineers for 1874, page 36. In the same volume, Part II, page 32, will be found the report of the survey made in 1870.

(2) *Original condition.*—The Rappahannock from Fredericksburg, the head of navigation, to the Chesapeake Bay is about 106½ miles in length measured on the charts. It enters Chesapeake Bay 119 miles below Baltimore. Its general course is southeast. Its width at Fredericksburg is about 300 feet, and it continues narrow with two exceptions, namely, at Tobago Bay and Green Bay as far as Occupacia Creek, 56½ miles below Fredericksburg, where its fluvial character disappears. At this point its width is about one-half a mile; from here it gradually widens in its course and becomes, at its mouth, 3½ miles wide. The tides range from 2.5 feet at the mouth to about 4 feet at Fredericksburg.

Freshets are of short duration, rising to about 20 feet at Fredericksburg and are but slightly felt at Port Royal, 29½ miles below.

The following table shows the highest water at Fredericksburg for each month from 1879 to 1885:

Month.	1878.	1879.	1880.	1881.	1882.	1883.	1884.	1885.
	Feet.	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*
January	.....	.....	.....	7.0	5.0	.....	10.0	4.5
February	.....	4.2	6.3	19.0	9.7	5.1	5.5	9.7
March	.....	3.7	6.3	5.5	6.0	5.0	9.5	.....
April	.....	4.0	7.5	4.0	10.0	4.6	3.9	.....
May	.....	4.5	6 5	3.7	6.0	4.4	4.1	.....
June	.....	3.5	3.5	4.0	3.6	3.6	5.7	.....
July	.....	3.5	3.5	3.7	3.8	3.8	3.9	.....
August	.....	3.7	3.5	3.8	4.5	4.2	3.4	.....
September	4.9	.....	4.0	4.5	5.3	4.5	3.4	.....
October	11.5	.....	3.5	3.6	4.0	4.4	3.5	.....
November	8.5	.....	3.5	3.4	4.0	3.6	3.6	.....
December	10.7	.....	3.3	6.5	4.5	3.4	4.2	.....

Relative order of months, arranged with reference to occurrence of freshets, as follows:

February (greatest occurrence), January, March, April, December, October, May, low-water months; September, November, June, July, August (least frequent freshets); highest known freshet, 23 feet, May, 1873.

The banks are generally high, and with few exceptions permanent in slope, and the country throughout the extent of the river is well cultivated, and has for many years been occupied by an intelligent and wealthy community of farmers.

In 1871 the depth at low water upon the principal bars was as follows: At Fredericksburg it was 4 feet at low water; at Spottswood it was 6; at Castle's Ferry and Farley Vale 8, feet; at Tobago Bay, below Nanzatico, and at Naylor's Hole it was 7 feet.

The following distances, from the railroad bridge at Fredericksburg to the steamboat landings are taken by scale from United States Coast Survey charts:

Distance to—	Miles.	Distance to—	Miles.
Wharf at Fredericksburg	0.270	Carter's	53.375
Fredericksburg Bar	0–1.000	Occupacia Creek (fluvial character ceases)	56.500
Pollock's Bar	1.500	Wharf near Naylor's Hole	60.875
Bernard's Bar	2.020	Naylor's Hole	62.500
Pratt's Reach Bar	3.510	Tappahannock	64.625
Spottswood Bar (upper)	4.190	Ware's	71.000
Spottswood Bar (lower)	4.730	Totusky River	71.500
Castle's Ferry Bar	8.160	Bowler's	74.000
Moss Neck Bar	10.820	Sharp's	76.500
Farley Vale Bar	12.630	Bay Port	80.250
Radcliffe's Bar	17.500	Water View	84.500
Hop yard	18.875	Monaskon	85.750
Clive	26.375	West Urbana or Robinson's	90.625
Canning	27.250	Urbana Creek	91.125
Port Conway	29.500	Merry Print } Mouth of Curratoman Millenbeck. } River.	95.875
Port Royal (freshets disappear)	29.500		
Camden	31.375	Carter's Creek Wharf } Mouth of Car- James's Wharf } ter's Creek.	97.500
Port Tobago	34.000		
Greenlaw's	35.750	River View	98.250
Spillman's	38.625	Mill Creek	100.625
Port Micon	42.375	North End	102.625
Saunders	45.000	Wilson's Wharf	105.625
Leedstown	47.500	Mouth of the river	106.500
Layton's	49.500		

(3) *Plan of improvement.*—According to the original project, the proposed cuts were to have a navigable depth of from 9 to 10 feet at low water with a width of 100 feet at bottom through all the bars. Training-dikes were recommended for the preservation of the depth, but the method of construction, position of the dikes, and estimate of cost were left for future determination.

In 1879 a general estimate was submitted which included these omissions, and also the cost of increasing the depth and width of the channel. It was not practicable to fix precisely the location of the dikes or the dimensions of the cuts, as the work advanced slowly, and changes must occur before the point of improvement could be reached.

The convenience of a general estimate is, however, obvious. The calculations were based upon a channel which should have a width of from 100 to 150 feet, and a depth of 10 feet at low water as far as Port Royal, 29½ miles below Fredericksburg, and thence to the mouth the channel should not be less than 200 feet in width with a depth of not less than 15 feet at low water. The estimate included such dikes as, at the time, seemed necessary. It was expressly stated that before beginning the improvement at any locality, a careful survey and final plan should be prepared. The total cost of the work was estimated to be $291,000.

(4) *Amount expended.*—From the adoption of the project in 1879 to the end of the fiscal year closing June 30, 1885, the amount appropriated is $77,000. Of this sum $24,159.34 have been expended between Fredericksburg and Farley Vale bars (a distance of 12.6 miles) in dredging 119,061.8 cubic yards of sand and silt up to June 30, 1885.

A larger sum has been expended on the construction of dikes between Fredericksburg and Farley Vale (12.6 miles) amounting, since the adoption of the present project in 1880, to $41,227.77. The balance, $11,612.89, will be expended in dredging, chiefly at Fredericksburg and Spottswood bars, which will be completed in the early part of the fiscal year ending

June 30, 1886. These sums amount to the total of the appropriation since June 14, 1880, or to $77,000. About one-fifth of the appropriation made July 5, 1884, has been expended in repairs made necessary by the damage done to the work during the previous year of suspension of operations. Suspension of work and slow progress on account of want of funds will necessarily increase the cost beyond the amount of the estimate.

(5) *Results obtained by work of improvement up to June* 30, 1884.—Between Fredericksburg and Farley Vale the channel has a depth of not less than 8.1 feet at low water, and a width of about 100 feet for 12½ miles, the distance which has been improved. The result of the improvement at each of the bars has been as follows:

The Fredericksburg Bar, which had before improvement but 4 feet at low water, has now from 8 to 10 feet.

Pollock's Bar, which had before improvement 7.3 feet, has now a minimum depth of 9 feet at low water.

Bernard's Bar, which had before improvement 8½ feet, has now a minimum depth of 9 feet at low water.

Pratt's Reach Bar, which had before improvement 8.3 feet, has now 9.4 feet at low water.

Spottswood Bar (upper), which had but 6 feet at low water, has now 8½ feet.

Spottswood Bar (lower), has from 9 to 10 feet, where formerly it had but 6 feet at low water.

Castle's Ferry and Farleyvale bars, which formerly had 8 feet, have now from 9 to 10 feet at low water.

The navigable depth at high water varies from 12 to 15 feet for a distance of about 12½ miles, as far as the improvement has advanced.

(6) *Work during the fiscal year ending June* 30, 1885.—No appropriation was made for the fiscal year preceding the present one, and no work was done upon the Rappahannock during that period.

For the current fiscal year $20,000 were appropriated July 5, 1884.

After a year of suspension a careful examination of the condition of the bars and dikes was necessary before operations could be begun.

Several of the dikes between Fredericksburg and Farley Vale, a distance of 12.6 miles, which had been left in an unfinished condition, were found much damaged by the floods of the previous winter. Other dikes had been injured, and some silting had occurred, chiefly at the Fredericksburg Bar.

For several years past it has been found economical to build the dikes by hired laborers, under the direction of an overseer.

It was thought advisable to again try the contract system. A part of the dikes was offered for contract, and a part was repaired by hired labor.

The following work has been done by hired labor:

Repair of dikes at Fredericksburg.—This work consisted in driving new piles at Dike No. 4, substituting bands for bolts, and fixing new ties.

Repair of dikes at Pollock's Bar.—This work consisted of replacing and bolting logs in Dike No. 3, in repairing Crib-dikes Nos. 1 and 2, and in sinking mattresses. (Pollock's Bar is 1.5 miles from Railroad Bridge at Fredericksburg.)

Dikes at Bernard's Bar, 2.02 miles from Railroad Bridge at Fredericksburg.—A new crib dike 109 feet in length was built at a cost of $5 per linear foot. Some repair of old dikes and some mattressing were done.

Repair of dikes at Pratt's Reach Bar, 3.51 *miles from Railroad Bridge at Fredericksburg.*—Logs were replaced and bolted on Dikes Nos. 1, 2, and 3. Tender piles were braced and mattresses sunk.

Repair of dikes at Castle's Ferry Bar, 8.16 *miles from Railroad Bridge at Fredericksburg.*—This work consisted in replacing and bolting logs.

Repairs at Spottswood Bar, 4.19 *to* 4.73 *miles from Railroad Bridge at Fredericksburg.*—This work consisted in mattressing.

Repairs at Farleyvale Bar, 12.63 *miles from Railroad Bridge at Fredericksburg.*—This work consisted in replacing and bolting logs.

DIKES BUILT BY CONTRACT.

The following is an abstract of the bids received in response to advertisement dated November 10, 1884, and opened December 5, 1884:

No.	Names.	Price per linear foot.	
		For constructing dikes as specified.	For repairing dikes as specified at Farleyvale Bar.
1	Henry Birch, 2105 Pennsylvania avenue, Washington, D. C	$3 60	$3 00
2	John H. Dager, Wilmington, Del	7 92	6 35
3	Richard M. Payn, 63 Quay street, Albany, N. Y	6 25	5 40

The work was assigned to Henry Birch, the lowest bidder, at $3.60 and $3 per linear foot. The contract was entered into December 20, 1884, and was approved by the Chief of Engineers on January 9, 1885.

The following table gives a detailed statement of the work executed under this contract. The contractor began operations on March 16, and work under the contract was closed on June 25, 1885:

Nature of work.	Distance from Railroad Bridge at Fredericksburg.	Length.	Total cost.	Cost per foot to Government.
	Miles.	*Feet.*		
Training dike No. 4, Pratt's Reach	3. 51	161. 25	$631 25	$3 91
Extension to Spur dike No. 4, Spottswood	4. 19 to 0. 73	24. 4	87 84	4 17
Extension to Spur dike No. 10, Spottswood	4. 19 to 4. 73	21. 00	89 60	4 25
Training dike No. 6½, at Spottswood	4. 19 to 4. 73	123. 75	477 14	3 85
Extension to Spur dike No. 12, Spottswood	4. 19 to 4. 73	20. 40	85 44	4 19
Extension to Spur dike No. 14, Spottswood	4. 19 to 4. 73	20. 40	85 44	4 19
Extension to Spur dike No. 18, Spottswood	4. 19 to 4. 73	20. 10	84 36	4 19
Repairs to Spur dike No. 1, Farleyvale	12. 63	84. 00	282 00	3 36
Repairs to Spur dike No. 2, Farleyvale	12. 63	42. 90	138 70	3 23
Total	12. 63	518. 2	1, 961 77	3 78

DREDGING DONE DURING THE FISCAL YEAR ENDING JUNE 30, 1885.

This work was done as heretofore, under contract.

The following is an abstract of the bids received in response to advertisement dated March 11, 1885, and opened April 15, 1885:

No.	Names.	Price for material.		
		Between spur dikes at distances less than 1 mile.	At distances of 1 to 2 miles.	In rear of longitudinal dikes.
		Cents.	*Cents.*	*Cents.*
1	Thomas P. Morgan, Washington, D. C	32	32	32
2	James Caler & Son, Norfolk, Va	19½	19¾	22¾
3	Baltimore Dredging Company, Daniel Constantine, President, Baltimore, Md.	19	19	19

The contract was assigned to Daniel Constantine, the lowest bidder, at 19 cents per cubic yard; was entered into April 23, and approved by the Chief of Engineers May 5, 1885. Work was begun June 11, 1885, in the turning-basin opposite the steamboat wharf at Fredericksburg. The material excavated was sand and gravel.

The following table shows the amount excavated to June 30, 1885:

Date.	Total net excavation.	Deposited between spur dikes.	Deposited above high-water mark.	Average daily excavation.
	Cub. yds.	*Cub. yds.*	*Cub. yds.*	*Cub. yds.*
Amount excavated from June 11 to June 30	3, 867. 8	3, 143. 8	1, 061	227. 5

In accordance with the project submitted July 26, 1884, and with the statements and explanations thereof submitted August 16, 1884, two surveys have been made; one at Tobago Bay, the other at Naylor's Hole. The object of these surveys was to obtain data for determining the obstructions to navigation at these localities, and for determining the best method of improving them.

Maps of Tobago Bay and Naylor's Hole are in preparation.

Relation of the work done to the entire project.—When the present appropriation of $20,000, under which work is now being done, is spent, about one-half of the estimate for the present project will have been exhausted. The formation of new bars has been anticipated in the estimate, but cannot be exactly stated.

The estimate will cover the work to be done if the annual appropriations are sufficiently large to prevent the increased cost of work arising from the necessity of continuing the contingent expense over a long period.

(7) *Appropriations made.*—Amount expended upon former project, $90,500.

The following appropriations have been made for the present project:

June 14, 1880	$25, 000
March 3, 1881	15, 000
August 2, 1882	17, 000
July 5, 1884	20, 000
Total	77, 000

These appropriations were made under the following general estimate for improving the river from Fredericksburg to the 15-foot curve near Tappahannock, a distance of 64½ miles:

(8) *Estimate:*

Estimate of 1879	$291,000
Amount appropriated up to July 5, 1884	77,000
Not yet appropriated	214,000

The following drawings accompany this report:

1. Chart of Fredericksburg Bar.
2. Chart of Spottswood Bar.

Money statement.

July 1, 1884, amount available		$50 93
Amount appropriated by act approved July 5, 1884		20,000 00
		20,050 93
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$6,491 29	
July 1, 1885, outstanding liabilities	2,004 95	
		8,496 24
July 1, 1885, amount available		11,554 69
Amount (estimated) required for completion of existing project		214,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		84,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

STATISTICS OF TRADE FOR 1884.

The committee on commerce and navigation have made no report for the year 1884.

Mr. McCracken, the chairman of this committee, states that there is very little, if any, change in the trade since their report for 1883.

For the itemized and tabulated statement of the trade for 1883, see Report of the Chief of Engineers for 1884, page 986.

The following is a summary giving the totals of report for 1883:

COMMERCE AND MANUFACTURES.

Total trade by water	$3,408,500
Total trade by rail	1,291,650
Grand total	4,700,150

MILLS, FACTORIES, BUSINESS HOUSES, ETC.

Number	59
Capital	$480,000
Amount of business	2,430,000

The shipments and receipts at the various landings below Fredericksburg are very large, but no returns have been recived.

K 7.

IMPROVEMENT OF TOTUSKEY RIVER, VIRGINIA.

HISTORY OF OPERATIONS.

(1) *Reference to reports.*—A report of a survey, made March 3, 1875, will be found in the Report of the Chief of Engineers for 1881, Part I, page 964.

(2) *Description.*—The Totuskey is an affluent of the Rappahannock, into which it empties 35 miles above its mouth.

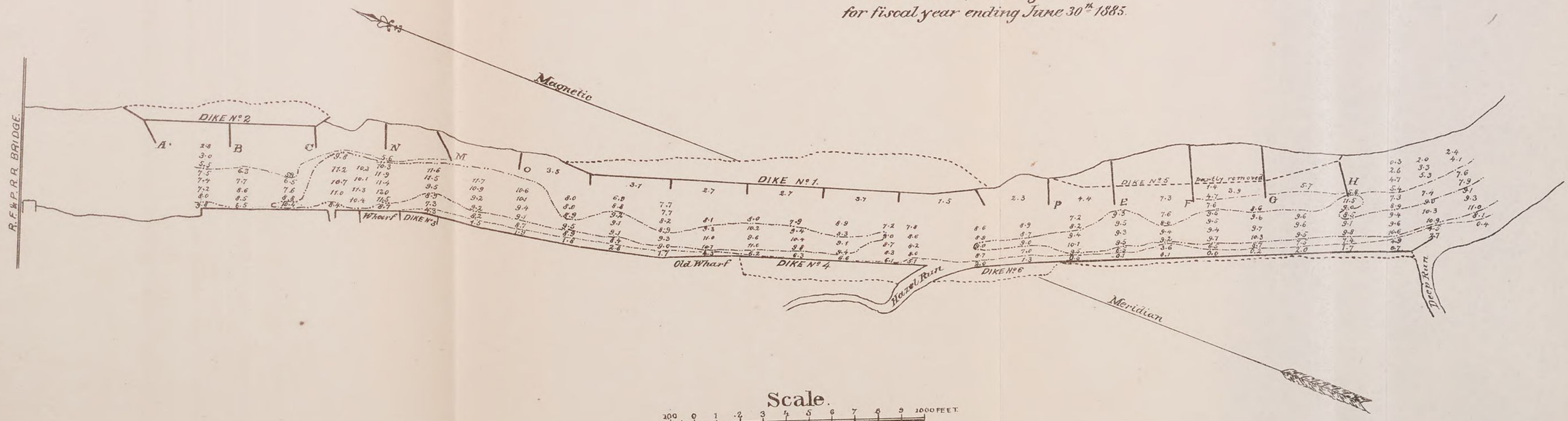
(3) *Original condition.*—It is navigable for 5 miles to a point where it is crossed by the county bridge. A bar off the mouth, over which 4½ feet can be carried at low water, and a bar in the creek, over which 2½

RAPPAHANNOCK RIVER

VIRGINIA

Fredericksburg Bar

To accompany the annual report of
S. T. Abert, U. S. Agent,
for fiscal year ending June 30th 1885.



Scale.

100 0 1 2 3 4 5 6 7 8 9 1000 FEET.

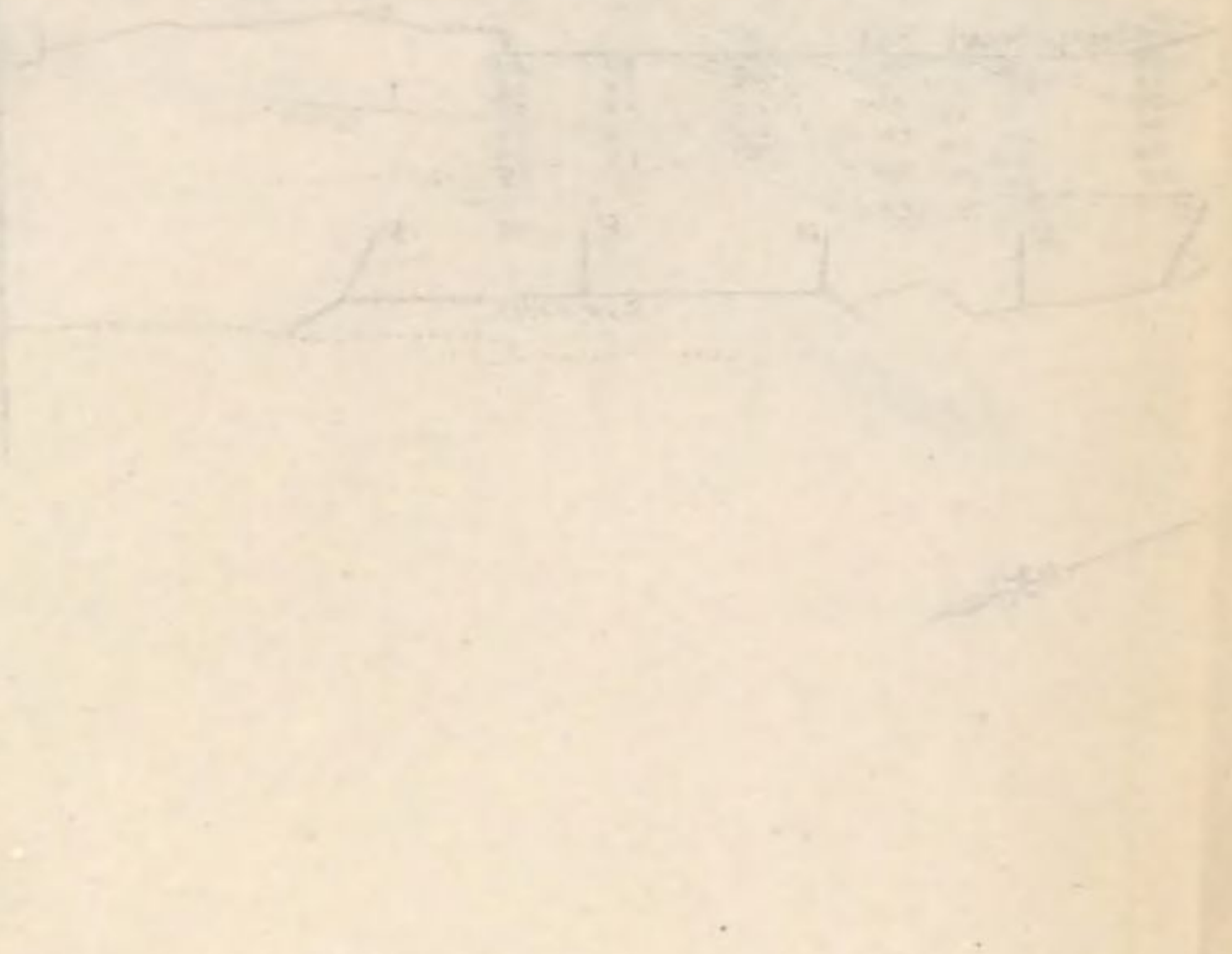
The soundings are expressed in feet and refer to Mean Low Water.

The 6 feet curve is represented thus: ----------

" 9 " " " " " : ·-·-·-·-·-

Mean range of Tide 3 feet.

H Ex1 pt2 v2 49 1

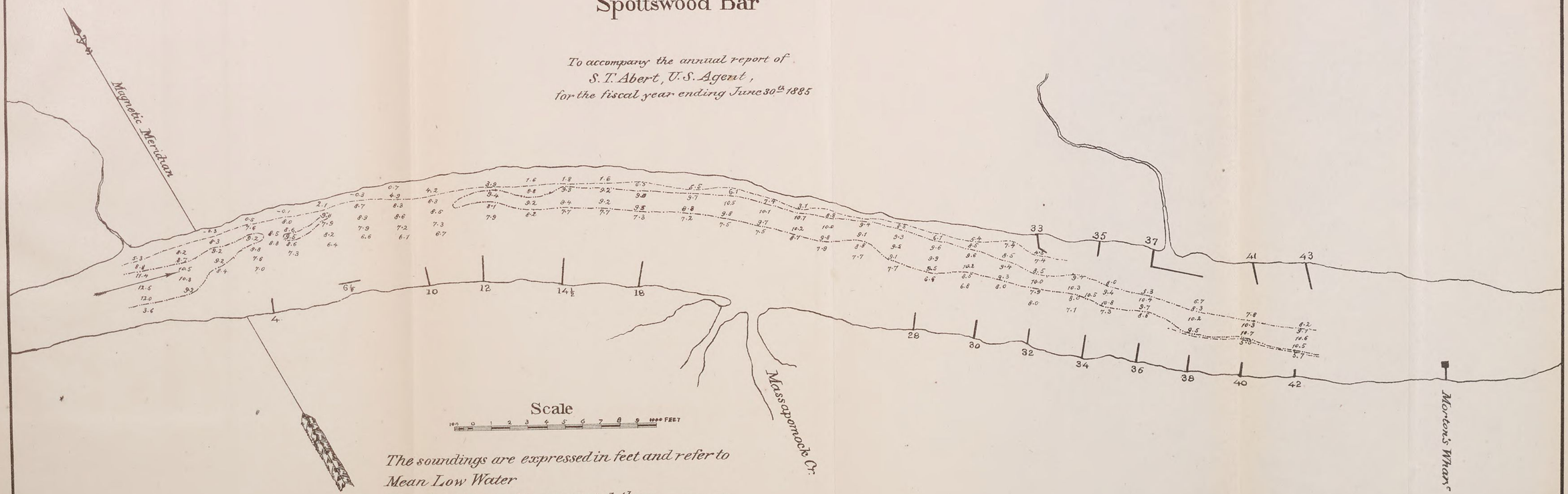


RAPPAHANNOCK RIVER

VIRGINIA

Spottswood Bar

To accompany the annual report of
S. T. Abert, U. S. Agent,
for the fiscal year ending June 30th 1885



The soundings are expressed in feet and refer to
Mean Low Water
The 6 feet curve is represented thus: - - - - - - - -
" 9 " " " " " ·---·---·---·
Mean range of Tide 3 feet

H Ex1 pt2 v2 491

feet can be carried, were the principal obstructions to navigation. The range of tide is 1½ feet.

(4) *Plan of improvement.*—The project of improvement consisted in building a dike 2,400 feet long at Booker's Bar in the creek, and in excavating a channel parallel with it, having a width of 60 feet and a depth of 8 feet at low water. No work was proposed upon the bar off the mouth.

(5) *Amount expended and results obtained.*—Ten thousand dollars have been expended in constructing a dike 2,117 feet in length. The depth on Booker's Bar has increased one-half a foot from the effect of the current, but it will be necessary to dredge the channel as proposed in order to obtain the required depth at once.

If Congress is disposed to complete the improvement I would recommend the appropriation of $12,000.

The following appropriations have been made:

June 14, 1880	$2,500
March 3, 1881	2,500
August 2, 1882	5,000

The work is in the collection district of Tappahannock, which is the nearest port of entry. The nearest light-house is Bowler's Rock, in the fifth light-house district.

Money statements.

July 1, 1884, amount available		$766 96
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884		366 14
July 1, 1885, amount available		400 82
Amount (estimated) required for completion existing project	12,000 00	
Amount that can be profitably expended in fiscal year ending June 30, 1887	12,000 00	
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

STATEMENT OF TRADE FOR THE YEAR 1884.

Mr. James F. Garland gives the following commercial statistics:

Natural products	$29,700
Manufactures	33,500
Total	63,200

K 8.

IMPROVEMENT OF URBANA CREEK, VIRGINIA.

HISTORY OF OPERATIONS.

(1) *Reference to reports.*—A history of operations to June 30, 1882, will be found in the Report of the Chief of Engineers for 1882, Part I, page 1029.

(2) *Description.*—This creek is a tidal tributary of the Rappahannock, and for vessels proceeding up-stream is the only harbor of refuge on the right or south bank of the river for a distance of 60 miles.

(3) *Original condition.*—The obstructions consisted in a bar off the mouth, over which only 6 feet could be carried at low water, and a bar which contracted the channel in the harbor.

(4) *Plan of improvement.*—It was proposed to make a cut through the bar at the mouth, with a width of 150 feet and a depth of 10 feet. This plan was extended in 1883 (see Report of 1884) to include the removal of the bar in the harbor. The sand-spit at the mouth was re-enforced against the tides by a wattled dike.

(5) *Results obtained and money expended.*—Since the first appropriation, March 3, 1879, $15,500 have been expended. With this sum 58,729 cubic yards of material have been removed at rates varying from 15 to 30 cents per yard.

At the close of the work the channel at the mouth was 120 feet wide and 10 feet deep, and the channel in the harbor had a width of from 80 to 400 feet and about the same depth.

(6) *Operations contemplated.*—With $5,000 or $6,000, which will complete the estimate, the channel at the mouth can be completed to a width of 150 feet, and the width of the harbor can be extended to 400 feet.

The following appropriations have been made:

March 3, 1879	$5,000
June 14, 1880	2,500
March 3, 1881	4,000
August 2, 1882	4,000
Total	15,500

Urbana is a port of entry, and is in the collection district of Tappahannock.

Money statement.

July 1, 1884, amount available	$68 59
July 1, 1885, amount available	68 59
Amount (estimated) required for completion of existing project	6,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	6,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

STATISTICS OF TRADE FOR 1884.

NATURAL PRODUCTS.

Articles.	Total value of shipments and receipts.	Articles.	Total value of shipments and receipts.
Bacon	$5,000	Grain	$5,000
Beef and other cattle	8,000	Railroad-ties	3,000
Coal	1,500	Wood	3,500
Eggs	800	Total	203,800
Fish and oysters	175,000		
Fruits, green and dried	2,000		

MANUFACTURES.

Fertilizers	2,000	Liquors	5,000
Flour	1,300	Mill machinery	4,000
Furniture	1,000	Merchandise, not included above	25,000
Groceries	10,000	Total	49,800
Hardware	1,000		
Leather	500		

Since the improvement of the channel two of the steamers of the Weems Line have been running regularly into the creek. The other steamer of the same line, in consequence of the narrow channel and insufficient depth of water, has been afraid to venture into the creek. There are two elbows in the channel the removal of which would make the entrance and exit much easier.

F. E. SUTTON.

K 9.

IMPROVEMENT OF MATTAPONI RIVER, VIRGINIA.

HISTORY OF OPERATIONS.

(1) *Reference to reports.*—A report and estimate were submitted May 2, 1875. A full description of the part of the river which requires improvement, about 36 miles in length, and an account of the obstructions to navigation will be found in the Report of the Chief of Engineers for the year 1880, Part I, page 770.

(2) *Description.*—The Mattaponi River rises near Bowling Green, Va., flows southeast, and empties into the York River at West Point, Va. It is navigable for 56 miles and can be made navigable for barges for 25 miles above Aylett's, the head of navigation.

(3) *Original condition.*—From Murdy's Bridge to Aylett's, snags obstructed the channel. From Aylett's to the head of Line Tree Bar, a distance of about $12\frac{3}{4}$ miles, the depth on the bar varies from $2\frac{1}{2}$ to $3\frac{1}{2}$ feet at low water. From the head of Line Tree Bar to the mouth the least depth is 6 feet at low water. The wrecks and snags between Aylett's and Latané's have not been removed. The tide is from 3 to $3\frac{1}{2}$ feet above low water.

(4) *Plan of improvement.*—It was proposed to remove the snags and wrecks, and to dredge a channel from the head of navigation to Line Tree Bar which should have a bottom width of 40 feet and a depth of $5\frac{1}{2}$ feet at low water. To preserve the depth in the channel it will be necessary to construct dikes.

(5) *Amended project.*—The first report and estimate, based upon a personal reconnaissance made in 1875, without instruments, were as correct as the circumstances would permit.

In the Annual Report of 1880 it is stated that before the work can be begun "a re-examination should be made of the changes which have taken place." Ten years have now elapsed, and a re-examination is still more important. I therefore submit charts and estimates of an instrumental examination of Robinson and Latané's bars, made at the close of the year 1884.

Robinson's Bar.—This bar is 9 miles below Aylett's. Its length is 3,500 feet. The width of the river is from 240 to 450 feet. The least depth is $2\frac{1}{2}$ feet at low water. In order to obtain a central width of 40 or 50 feet it will be necessary to make a cut with a width of 100 feet and a depth of 6 feet. The number of cubic yards to be excavated is 40,000. Half of this quantity can be deposited behind the dikes, and the remainder can be placed on the adjacent marsh; 2,331 linear feet of dike will be required, which should be connected with the shore to prevent littoral currents.

Latane's Bar.—This bar is about 1 mile below Robinson's. Its length between the curves of 6 feet depth is 4,130 feet. The width of

the river is from 400 to 500 feet. The least depth is 3½ feet at low water. The amount to be excavated in order to make a channel 40 feet wide at bottom and 6 feet deep is 31,000 cubic yards. This material can be deposited in the shallow water alongside of the channel; 750 feet of dikes will be required at the upper end of the bar.

SUMMARY OF ESTIMATES FOR ROBINSON AND LATANÉ'S BARS.

Robinson's Bar, 40,000 cubic yards, at 35 cents	$14,000
Dike, 2,330 feet, at $3	6,990
Latané's Bar, 31,000 cubic yards, at 30 cents	9,300
Dike, 750 feet, at $3	2,250
	32,540
Add 15 per cent. for contingencies	4,881
Total	37,421
Or, in round numbers, for the two bars	38,000

From Latané's Bar to the mouth of the river no work is necessary at the present time, the depth being not less than 5½ feet at low water.

Original estimate	$34,100
Amount appropriated	8,300
Balance due on original estimate	25,800
Estimate for Robinson and Latané's bars	38,000
Amount of appropriation still due	63,800

The appropriation of July 5, 1884, is too small for economical work and will be held until further appropriation is made.

The following appropriations have been made:

July 14, 1880	$2,500
March 3, 1881	3,300
July 5, 1884	2,500

The work is in the collection district of Richmond, the nearest port of entry. The nearest light-house is Bell Rock.

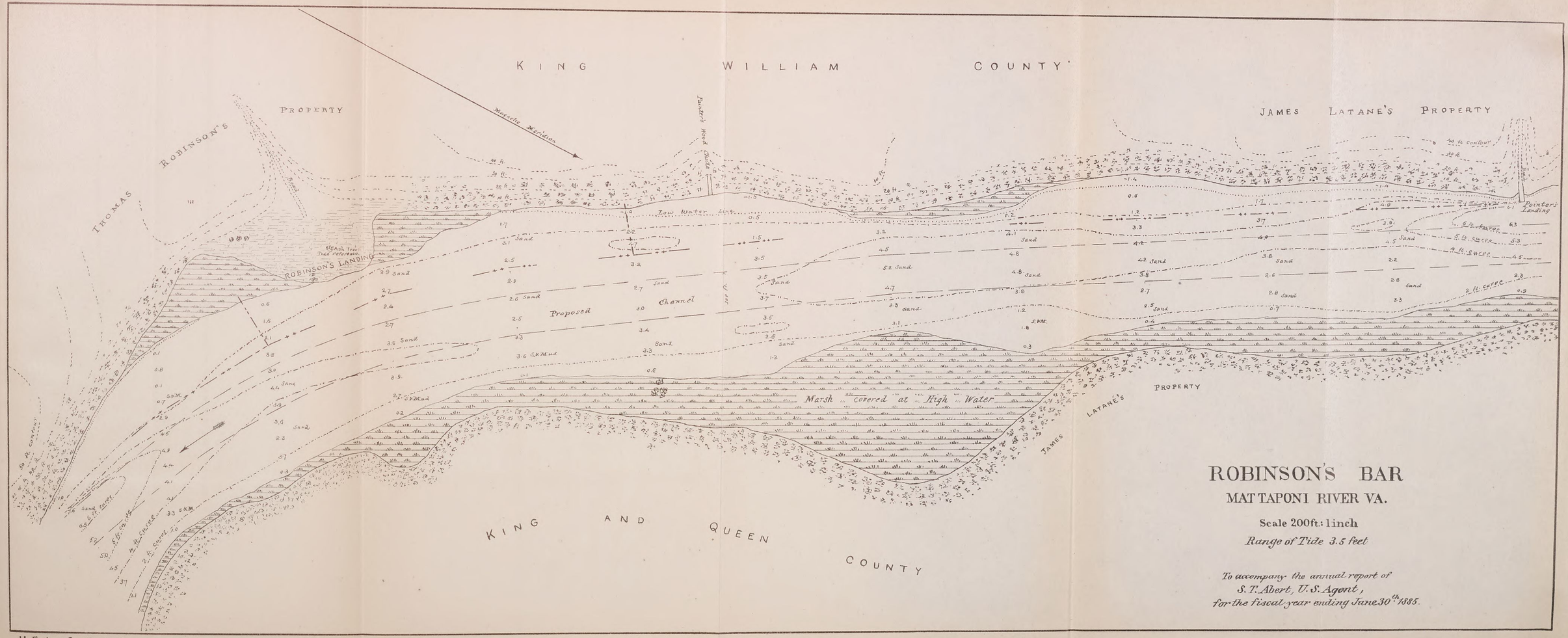
The following drawings accompany this report:

1. Chart of Robinson's Bar.
2. Chart of Latané's Bar.

Money statement.

Amount appropriated by act approved July 5, 1884	$2,500	00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	223	80
July 1, 1881, amount available	2,276	20
Amount (estimated) required for completion of existing project	63,800	00
Amount that can be profitably expended in fiscal year ending June 30, 1887	33,000	00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.



ROBINSON'S BAR

MATTAPONI RIVER VA.

Scale 200ft.: 1inch

Range of Tide 3.5 feet

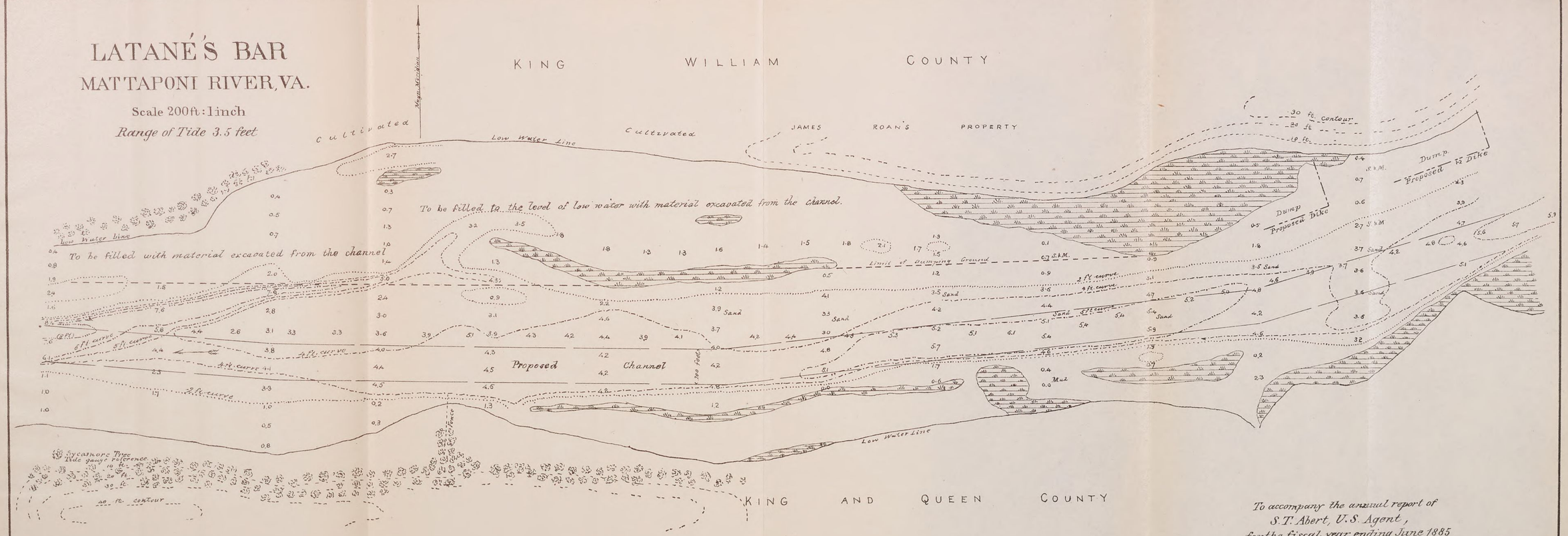
To accompany the annual report of
S. T. Abert, U. S. Agent,
for the fiscal year ending June 30th 1885.

H Ex1 pt2 v2 491

LATANÉ'S BAR
MATTAPONI RIVER, VA.

Scale 200 ft : 1 inch

Range of Tide 3.5 feet



To accompany the annual report of
S. T. Abert, U. S. Agent,
for the fiscal year ending June 1885

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STATISTICS OF TRADE FOR 1884.

NATURAL PRODUCTS.

Articles.	Total value of shipments and receipts.	Articles.	Total value of shipments and receipts.
Bacon	$6,000	Lard	$4,000
Beef and other cattle	5,600	Lumber (sawed)	25,000
Bark	1,000	Peas and beans	9,000
Coal	2,000	Peanuts	1,100
Eggs	7,000	Potatoes	1,000
Fish and oysters	2,000	Poultry	4,000
Fruits (green and dried)	4,000	Sheep and lambs	5,000
Furs	3,000	Sumac	16,000
Grain	25,500	Staves and barrel timber	30,000
Horses and mules	5,000	Tobacco	10,000
Hoop-poles	10,000	Wood	230,000
Hay	3,000	Wool	2,000
Hides	1,000		
Hogs	1,500	Total	419,700
Iron (bar, pig, and scrap)	6,000		

MANUFACTURES.

Agricultural machines	4,000	Furniture	5,000
Agricultural implements	4,000	Groceries	60,000
Castings	1,000	Hardware	8,000
Cornmeal	6,000	Leather	2,000
Drugs and chemicals	8,000	Mill-feed	5,000
Fertilizers	30,000	Wagons, carriages, &c	3,000
Liquors	7,000	Woven fabrics	75,000
Mill machinery	3,000		
Flour	10,000	Total	231,000

Mills, factories, business houses, &c.

Description.	No.	Capital.	Amount of business in 1884.
Stores	41	$82,000	$250,000
Mills	16	32,000	80,000
Canning factory	1	3,000	8,000
Total	58	117,000	338,000

Vessels engaged in trade during 1884.

Description.	No.	Total tons.	Greatest draught.
			Feet.
Steam	3	90	9
Sail	520	104,000	11
Barges	12	1,500	6
Flat-boats	7	294	4
Total	542	105,884	.....

The above statistics are furnished by Capt. B. F. Eaton, who says:

"While the Mattaponi River is in such a deplorable condition and navigation so very bad it is a hard matter to charter a vessel or steamer to navigate its waters, as their owners are afraid of logs, bars, and snags, all of which we have to contend with. There is no chance of any new industry until we have better navigation. Navigation is so very bad that vessels charge more freight to come to Mattaponi River than to any other place I could mention the same distance away.

"B. F. EATON,
"*Captain Steamer R. E. Lee.*"

K 10.

IMPROVEMENT OF PAMUNKY RIVER, VIRGINIA.

HISTORY OF OPERATIONS.

(1) *Reference to reports.*—A report of a personal examination of 30 miles of this river, with an estimate for removing the obstructions to navigation, were submitted May 21, 1875, and will be found in the Report of the Chief of Engineers for 1880, page 773. A history of operations until the close of the fiscal year ending June 30, 1882, will be found in the Report of the Chief of Engineers for that year. No work has been done since that date.

(2) *Description of original condition.*—Pamunky River rises in Osage County, flows southeast, and empties into the estuary of York River, at West Point, Va. Its length from Hanovertown, the head of navigation, to the mouth is about 80 miles.

Between Hanovertown and New Castle Ferry, a distance of 9 miles, the least depth on the three bars varies from $1\frac{1}{2}$ to $2\frac{1}{2}$ feet at low water. This part of the river can be made navigable for lighters or light-draught steamers. Between New Castle Ferry and Piping Tree, a distance of about 19 miles, two bars only require improvement at the present time.

The first of these is called Skidmore's Bar, and is 13 miles below Hanovertown. The least depth is 5.8 feet at low water and in a narrow channel.

The second is $19\frac{3}{4}$ miles below Hanovertown, and is called Fox's Bar, or Spring Bar. The least depth at low water is 5 feet.

(3) *Plan of improvement.*—The plan of improvement consisted in removing the logs, trees, snags, and wrecks which obstructed navigation between Hanovertown and Garlic's Mill, which is below Piping Tree, and in dredging through the bars from Hanovertown to Piping Tree. From Hanovertown to Wormley's Landing the cut will be 3 feet deep; from Wormley's Landing to New Castle Ferry it will be 5 feet deep; below the Ferry the cuts will be from 6 to 7 feet deep at low water.

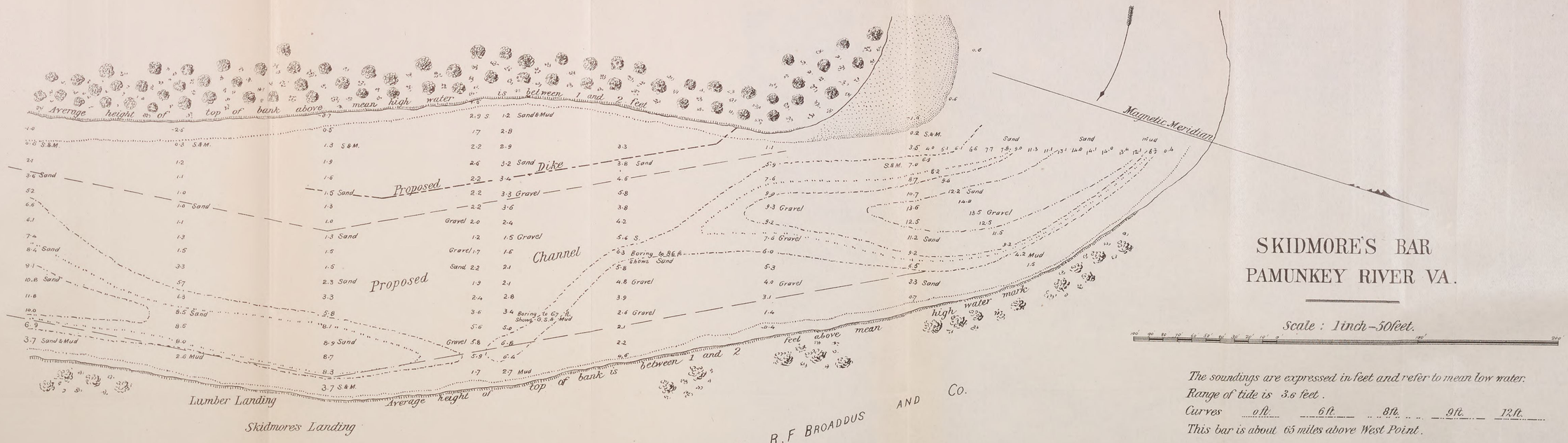
The first estimate was based upon a personal examination made without instruments, and was submitted in 1875. In my report for 1880 it was stated that before work could be begun "a re-examination should be made of the changes which have taken place in the channel during the five years which have elapsed."

(4) *Survey of* 1884.—In the fall of 1884, nearly ten years after the first examination was made, the first instrumental survey of Skidmore and Fox's bars was completed. Charts and estimates were made for the improvement of these bars, according to the original project, which are submitted with the following description, in which the bars are taken in the order encountered in descending the stream.

Skidmore's Bar, sometimes called Upper Bassett's, 13 miles from Hanovertown.—The low-water width of the river at this point is 120 feet at the upper end and 142 at the lower end of the bar. There is a narrow channel on the bar, having a depth of 5.8 feet at low water. The distance to be dredged is about 600 feet.

Along the shore and behind the dikes there can be deposited 800 cubic yards.

Upon the bank of the river there must be deposited about 5,500 cubic yards. The channel is to be 100 feet wide by 7 feet deep at low water.


HANOVER COUNTY
Average height of top of bank above mean high water is between 1 and 2 feet
Magnetic Meridian
Proposed Dike
Proposed Channel
Lumber Landing
Skidmores Landing
Average height of top of bank is between 1 and 2 feet above mean high water mark
PROPERTY OF R.F BROADDUS AND CO.
Cultivated
KING WILLIAM COUNTY

SKIDMORE'S BAR
PAMUNKEY RIVER VA.

Scale : 1 inch = 50 feet.

The soundings are expressed in feet and refer to mean low water.
Range of tide is 3.6 feet.
Curves 0 ft. 6 ft. 8 ft. 9 ft. 12 ft.
This bar is about 65 miles above West Point.

To accompany the annual report of
S. T. Abert. U.S. Agent.
for the fiscal year ending June 30. 1885.

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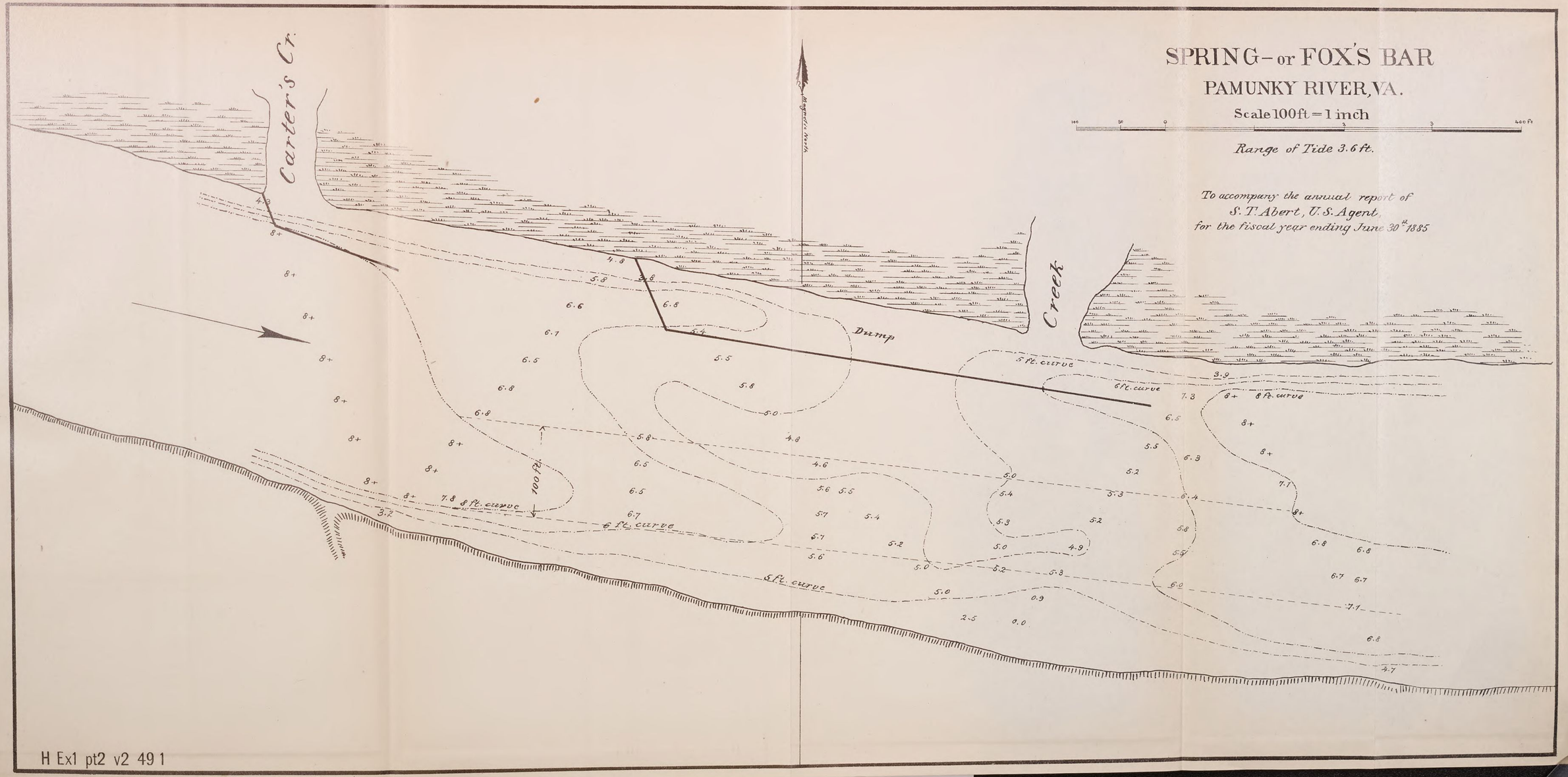

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ESTIMATE.

6,300 cubic yards, at 35 cents	$2,305
300 linear feet of dike, at $3	900
	3,205
Add 20 per cent. for contingencies	641
Total	3,846

Fox's Bar, sometimes called Spring Bar, 19¾ miles from Hanovertown.—The width of the river at high water is 350 feet. The least depth, at low water, on the bar is 5 feet.

The distance to be dredged is 600 feet. The cut is to be 100 feet wide by 7 feet deep at low water. The tide is 3½ feet. The material is to be deposited upon the bank or on the marsh.

ESTIMATE.

4,300 cubic yards of material, at 35 cents	$1,805
620 linear feet of dike, at $3	1,860
	3,665
Add 20 per cent. for contingencies	733
Total	4,398

The cost of improving Skidmore and Fox's bars will be $8,300.

(5) *Operations proposed for the fiscal year ending June* 30, 1886.—Nothing will be done during the year. The balance in the Treasury, being too small for economical work, will be retained for further operations if Congress is disposed to continue the appropriations.

The original estimate was	$20,000
Estimate for Skidmore and Fox's bars	8,300
	28,300
Deduct appropriations amounting to	7,500
Amount due on estimates	20,800

The following appropriations have been made:

June 14, 1880	$2,500
March 3, 1881	2,500
August 2, 1882	2,500
Total	7,500

The work is in the collection district of Richmond, which is the nearest port of entry. The nearest light-house is Bell Rock.

The following drawings accompany this report:

1. Map of part of Pamunky River.*
2. Chart of Skidmore's Bar.
3. Chart of Fox's or Spring Bar.

Money statement.

July 1, 1884, amount available	$2,328	02
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	451	63
July 1, 1885, amount available	1,876	39
Amount (estimated) required for completion of existing project	20,800	00
Amount that can be profitably expended in fiscal year ending June 30, 1887	20,800	00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

* Omitted.

STATISTICS OF TRADE FOR 1884.

Natural products.

Articles.	Total value of shipments and receipts.
Bacon	$500
Coal	1,000
Dairy products, poultry, and eggs (each $500)	1,500
Fish and oysters	1,000
Grain	200,000
Hay	1,000
Lumber, sawed	300,000
Peas, beans, and peanuts	1,500
Potatoes	1,000
Railroad-ties	100,000
Sumac	50,000
Wood	500,000
Wool	500
Total	1,158,000

The foregoing statistics, furnished by Mr. W. A. Willeroy, show the trade at his landing during the year 1884, transported chiefly by his barges.

No statistics have been received this year from any other quarter.

The total trade of the Pamunky last year, both by water and rail, as given by Mr. J. S. Neale, aggregated over $9,000,000.

K 11.

IMPROVEMENT OF YORK RIVER, VIRGINIA.

HISTORY OF OPERATIONS.

(1) *Reference to reports.*—A report of the survey of the bars at West Point, Va., and off Potopotank Creek, will be found in the Report of the Chief of Engineers for 1880, page 897. Work done since that date will be found in subsequent annual reports.

(2) *Original condition.*—The Pamunky and Mattaponi unite at West Point in forming the York River. The latter then follows a southeasterly direction for a distance of 41 miles, when it empties into Chesapeake Bay, about 16 miles in a line north of Fortress Monroe. Its course from West Point is noticeably straight for 31 miles. Its average width, as far as Yorktown, a distance of 26 miles, is 1½ miles.

Before improvement, navigation was obstructed by two bars, one at West Point, about 2.1 miles in length, the other at Potopotank Creek, about 2,200 feet in length.

The depth at West Point, at low water, was 15½ feet; the depth at Potopotank Creek was 18½ feet at low water. With the exception of these two bars the depth in the channel was not less than 20 feet at low water.

(3) *Plan of improvement.*—Three estimates have been submitted (1) for dredging a channel 200 feet wide and 20 feet deep at low water; (2) for dredging a channel 200 feet wide and 22 feet deep at low water; (3) for dredging a channel 400 feet wide and 22 feet deep at low water.

The last estimate amounted to $256,000 and was recommended for the following reasons: A channel dredged to a width of 400 feet will, by the caving of the sides of the cut, be reduced within a year to the

width of 300 feet. A further reduction of width will be caused at the confluence of the Mattaponi and Pamunky by the deposit of material brought down by those rivers. The estimates did not include the construction of a dike for counteracting this effect or for making the cut permanent. For economy the sum of $256,000 should be granted in four annual appropriations.

(4) *Amount expended.*—The total amount of appropriations up to June 30, 1884, is $60,000, which have been expended in dredging 327,512 cubic yards of material up to June 30, 1884.

(5) *Results obtained.*—At Potopotank Creek 58,809 cubic yards of material have been dredged (in 1881), at the rate of 15 cents per cubic yard, which has given a channel 105 feet wide, and 22 feet deep at low water. At West Point 268,703 cubic yards of material have been dredged (in 1881, 1882, and 1883), at rates varying from 13 to 16 cents per cubic yard, which has given a channel varying in width from 100 to 146 feet, and 22 feet in depth, for a distance of 2.1 miles.

(6) *Work done during the fiscal year ending June* 30, 1885.—This work is done by dredging under contract. The following is an abstract of the bids opened November 20, 1884:

No.	Names.	Price per cubic yard.	Time of commencement.	Time of completion.	Remarks.
		Cents.			
1	Henry Birch, Washington, D. C.	35	Ten days after work is awarded.	June 30, 1885	One dipper dredge and one clam-shell or grapple dredge.
2	Thomas P. Morgan, Washington, D. C.	8½	Dec. 15, 1884	June 30, 1885	One clam-shell dredge, daily average 1,000 cubic yards.
3	New York Steam Dredging Company, New York City.	32	Jan. 1, 1885	June 1, 1885	One clam-shell dredge.
4	Baltimore Dredging Company, Baltimore, Md.	$12\frac{8}{10}$	Mar. 1, 1885	June 1, 1885	One combination dredge.
5	James Caler & Son, Norfolk, Va.	$9\frac{7}{10}$	On awarding of contract.	June 1, 1885	One dipper dredge.
6	National Dredging Company, Wilmington, Del.	30	.....	May 1, 1885	
7	George C. Fobes & Co., Baltimore, Md.	12½	Dec. 15, 1884	June 1, 1885	One or more grapple dredges.

The contract was assigned to Thomas P. Morgan, of Washington, D. C., the lowest bidder, at 8½ cents per cubic yard. It was entered into December 1, and approved by the Chief of Engineers December 6, 1884. Work was begun February 12, 1885, and progressed slowly on account of the defective plant; 75,917 cubic yards were dredged up to June 30, 1885.

When the last appropriation is spent about $\frac{1}{3.2}$ of the entire estimate of $256,000 will have been expended in doing between one-third and one-half of the work proposed at West Point, and about three eighths of the work proposed at Potopotank Creek.

With respect to the object aimed at by the whole improvement, the present condition is as follows: At Potopotank Creek at the close of the work in March, 1881, the depth left on the bar was 22 feet at low water, and the width was 105 feet, or about one-fourth of the prescribed width.

No work has been done at Potopotank Creek since that date. At West Point the width proposed for the cut was 400 feet, and the depth 22 feet at low water. The least depth on the bar June 30, 1885, was 17½ feet, and the average width was 150 feet, or about three-eighths of the width proposed in the project. The greater part of the new cut has a depth of 22 feet at low water.

No exact estimate can be given of the silting of the channel which occurs at the confluence of the Mattaponi and Pamunky rivers. The amount of silting is now being observed. A plan will be submitted for preventing injury to the channel from this cause, as soon as the data relating to the subject can be collected.

Work under the present contract will be completed in the early part of the next fiscal year.

The following appropriations have been made:

June 14, 1880	$10,000
March 3, 1881	25,000
August 2, 1882	25,000
July 5, 1884	20,000
Total	80,000
Original estimate	$256,000
Amount appropriated	80,000
Due on estimate	176,000

The work is in the collection district of Richmond, Va., which is the nearest port of entry. The nearest light-house is Bell Rock in the fifth light-house district.

A chart of the bar at West Point, Va., accompanies this report.

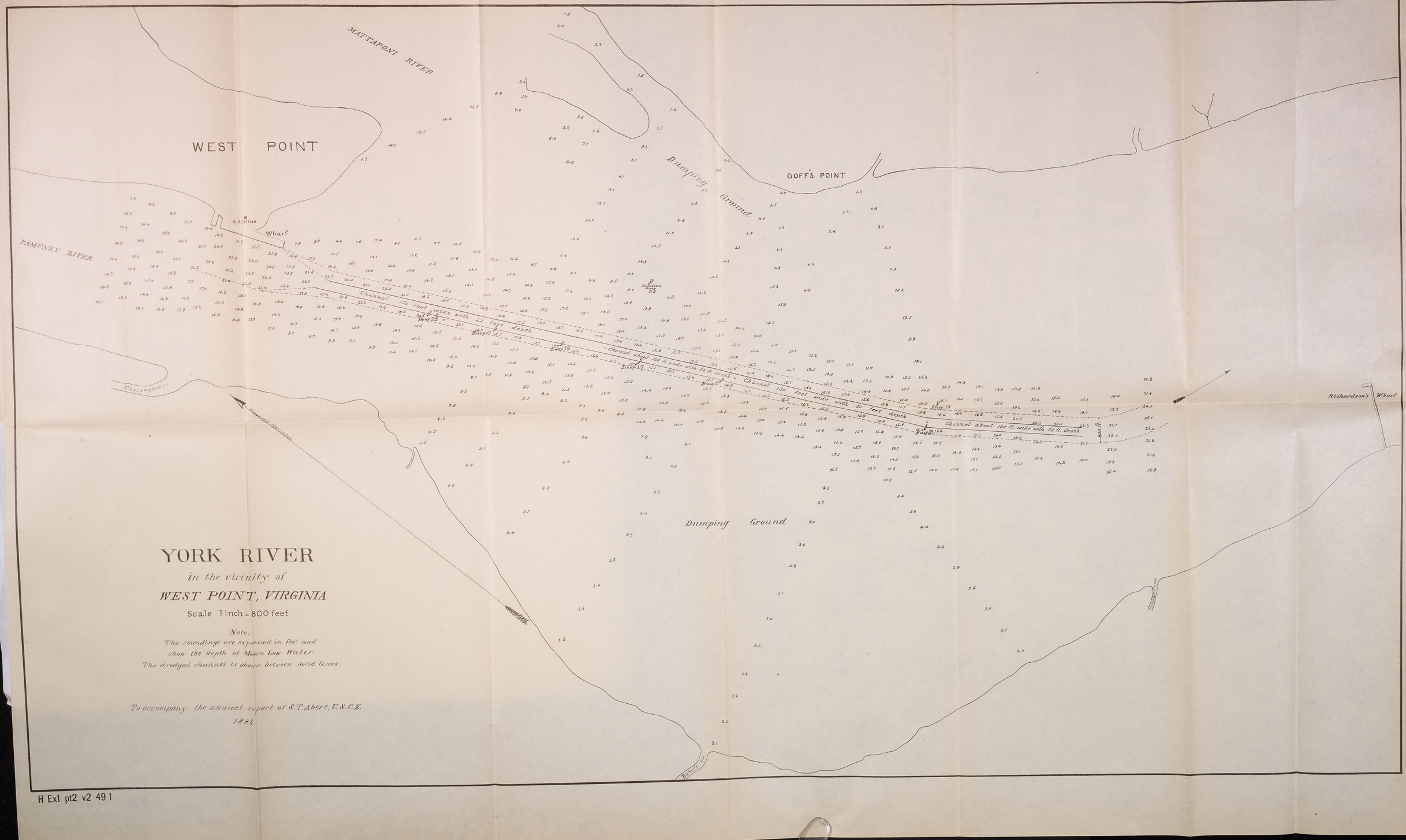
Money statement.

July 1, 1884, amount available		$2,402 30
Amount appropriated by act approved July 5, 1884		20,000 00
		22,402 30
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$8,121 30	
July 1, 1885, outstanding liabilities	2,114 31	
		10,235 61
July 1, 1885, amount available		12,166 69
Amount (estimated) required for completion of existing project		176,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		90,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

STATISTICS OF TRADE FOR 1884.

NATURAL PRODUCTS.

Articles.	Value of shipments and receipts.	
	Trade by water.	Trade by rail.
Bacon	$231,028	$14,918
Bark	88,400	88,400
Coal	.....	20,000
Cotton	11,025,000	12,250,000
Eggs	67,200	56,000
Fish and oysters	45,000	20,000
Grain	43,000	28 000
Hides	76,400	76,400
Ore (silver)	51,500	40,000
Lumber (sawed)	117,000	72,000
Logs	201,000	120,500
Potatoes	27,800	.....
Railroad ties	40,000	.....
Sumac	52,000	44,500
Tobacco	4,800,000	4,800,000
Wood	65.000	.....
Rosin	85,000	85,000
Total	17,015,328	17,715,718



YORK RIVER

in the vicinity of

WEST POINT, VIRGINIA

Scale 1 inch = 800 feet

Note:
The soundings are expressed in feet and show the depth at Mean Low Water.
The dredged channel is shown between solid lines.

To accompany the annual report of S.T. Abert, U.S.C.E.
1864

H Ex1 pt2 v2 491

WEST

STATISTICS OF TRADE FOR 1884—Continued.

MANUFACTURES.

Articles.	Value of shipments and receipts.	
	Trade by water.	Trade by rail.
Fertilizers	.....	$309,500
Flour	$98,700	128,000
Furniture	92,400	95,000
Mill machinery	.....	925,000
Wagons, carriages, &c	138,000	.....
General merchandise	9,940,600	.....
Total	10,269,700	1,457,500

Mills, factories, business houses, &c.

Description.	No.	Capital.	Amount business in 1884.
Cotton compress	1	$250,000	$2,930,000
Oyster-packing house	1	500	2,500
General stores	14	20,000	125,000
Total	....	270,500	3,057,500

Vessels engaged in trade during 1884.

Description.	No.	Total tons.	Greatest draught.
			Feet.
Steam	494	454,400	21½
Sail	214	85,600	22
Total	708	540,000	.....

The above report of statistics includes the trade of the Piedmont Air Line, centering at West Point, its terminus, and also cord-wood, railroad-ties, and sumac shipped from the Mattaponi and Pamunky rivers.

E. WILKINSON.

K 12.

IMPROVEMENT OF CHICKAHOMINY RIVER, VIRGINIA.

HISTORY OF OPERATIONS.

(1) *Reference to reports.*—The report of a personal examination with an estimate for improvement will be found in the Report of the Chief of Engineers for 1875, Part II, page 170.

An estimate for improving the bar at the mouth was submitted in 1882. (See Report of Chief of Engineers for 1882, page 1041.)

(2) *Description of original condition.*—The Chickahominy River rises in Henrico County, Virginia, 12 miles northwest of Richmond; flows southeast, and empties into the James River, 40 miles from the mouth and near Newport News. Its length from Forge Bridges to the James is about 44 miles. Between Forge Bridges and Windsor Shades the navigation is confined to lighters, and the chief obstruction at the time of survey consisted in snags and logs. At Windsor Shades, 19 miles below Forge Bridges, the depth was 4.5 feet. At Old Fort Bar it was

about 5 feet, and at Binn's Bar, 22 miles from Forge Bridges, the depth at low water was 4 feet. Thence no obstruction is encountered until the bar at the mouth is reached. Over this bar 11 or 12 feet could be carried at low water in the year 1882. The depth is influenced by the wind.

(3) *Distances.*—The following table of distances is prepared for this report:

	Miles.
Forge Bridges	0
Holly Landing	7
Winn Landing	16.5
Windsor Shades Bar	19
Old Fort Bar	
Binn's Bar	21
Bar at the mouth	44

(4) *Plan of improvement.*—It was proposed to improve the river for the length of 19 miles between Forge Bridges and Windsor Shades by removing the logs, trees, and snags, and subsequently, if required by the increase of trade, to dredge a channel through the bar.

No estimate was submitted for this part of the improvement. It was also proposed to cut a channel through the bars at Windsor Shades, Old Fort, and Binn's with a width of 100 feet and a depth of 8 feet at low water. The improvement was to be made at the mouth of the river by cutting a channel through the bar with a width of 200 feet and a depth of 15 feet.

(5) *Amount expended.*—Ten thousand dollars have been expended at Windsor Shades, Old Fort, and Binn's bars, and $5,000 at the mouth, making a total of $15,000. With this sum 45,197 cubic yards of material were removed from Windsor Shades, Old Fort, and Binn's bars, at the rate of 14 to 14.9 cents per cubic yard; and 19,859 cubic yards were removed from the bar at the mouth, at 22½ cents per cubic yard.

(6) *Results obtained.*—At Windsor Shades the cut was made with a width of 100 feet and a depth of 8 to 9 feet at low water. At Old Fort Bar a cut was dredged to a width of 100 feet and a depth of 8 to 9½ feet; but by filling at the side the width has since been reduced to 75 feet. At Binn's Bar the original width of cut was 200 feet, but subsequently was reduced by the caving of the sides of the cut to 160 feet. The depth is from 7½ to 8½ feet at low water.

A cut was made through the bar at the mouth with a width of 90 feet, a depth of 14, and a length of 1,800 feet.

No work has been done since 1883.

(7) *Future operations.*—The cut at the mouth should be made 200 feet wide, as originally projected, and the channel through the bar above should have the dimensions proposed.

The estimate for the bars in the river amounted to	$11,000
The estimate for the bars at the mouth amounted to	18,000
Total	29,000
Amount of appropriation	15,000
Balance due on appropriation	14,000

The following appropriations have been made:

June 13, 1878	$5,000
March 3, 1879	1,000
January 14, 1880	2,000
March 3, 1881	2,000
August 2, 1882	5,000
Total	15,000

The work is in the collection district of Richmond, which is the nearest port of entry. The nearest light-house is Deep Water Shoal light-house, in the fifth light-house district.

Money statement.

Amount (estimated) required for completion of existing project	$14,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	14,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

STATISTICS OF TRADE FOR 1884.

Natural products.

Articles.	Total value of shipments and receipts.
Hay	$50,000
Lumber (sawed)	50,000
Logs	10,000
Railroad ties	100,000
Wood	200,000
Total	410,000

The vessels engaged in trade during 1884 were: One tug of 50 tons, with draught of 6 feet, making one hundred round trips; two hundred sail vessels, with greatest draught of 12 feet and greatest tonnage 600.

There are on the river and tributary thereto about twenty mills and business houses, doing a business of $200,000 annually.

The improvements made on the river seem to stand well at an average depth of 12 feet.

I would call your attention to two other shallow places in the river: One just below Binn's Wharf, the other just above my wharf. The captains say there are only 9½ feet of water, and vessels frequently ground on these bars. I would suggest that they be deepened to 12 feet. The cost would be about $4,000.

C. PERKINS.

NOTE.—The depths given above probably refer to high water.

K 13.

IMPROVEMENT OF STAUNTON RIVER, VIRGINIA (BETWEEN RANDOLPH STATION AND BROOK NEAL).

HISTORY OF OPERATIONS.

(1) *Reference to reports.*—A report of an examination of the Staunton River between Brook Neal and Randolph Station (formerly Roanoke), on the Richmond and Danville Railroad, will be found in the Report of the Chief of Engineers for 1879, Part I, page 622. A report of a survey and estimates will be found in the Report for 1880, page 780. For history of operations since that date see the subsequent Annual Reports.

(2) *Original condition.*—The principal source of the Staunton is not far from the Peaks of Otter, in Bedford County. Its length is about 200 miles. It unites at Clarksville with the Dan River and becomes thereafter the Roanoke. The part of the river under consideration between Brook Neal and Randolph Station is about 31½ miles in length. Its course is tortuous, but the general direction in a line joining the ter-

minal points above mentioned is southeast. The banks of the river are from 12 to 22 feet in height, and are well protected by a fringe of willows and larger trees. The river bottom is fertile, and is said to be the most productive tobacco land in the State of Virginia.

The annual freshets are often high; that of 1877 rose to 43 feet above low water at Cole's Ferry, 10 miles below Brook Neal. The effect is generally salutary, as they leave a rich deposit of alluvial soil, which fertilizes the land. The width varies from 260 to 300 feet.

Although the least depth on the bars at low water is not more than half a foot, yet during ordinary stages the river presents a navigable depth which enables the planters to send their tobacco to the Richmond and Danville Railroad.

The greatest observed fall was 1.2 feet in 130 feet in length. All the natural slopes can easily be reduced to 10 feet to the mile at a moderate cost.

(3) *Plan of improvement.*—According to the original plan it was proposed to employ spur-dikes and rock excavation to make a channel not less than 35 feet wide and 2 feet deep at low water. The estimate amounted to $68,700.

(4) *Amount expended.*—The amount of appropriations up to June 30, 1884, is $22,500.

(5) *Results obtained.*—The length of the channel improved up to June 30, 1884, was 7 miles, making an unobstructed navigation of 10 miles at low water.

The localities of the work were: (1) Below Clark's Shoals, 3½ miles above the railroad bridge, where twelve spur-dikes were constructed in 1881–'82. (2) Horseback Shoal, 8 miles above the bridge, where a length of 5 miles was excavated in 1882–'83. (3) Hawk Mountain, 10 miles above the bridge, where a channel about a half mile in length was excavated in 1880–'81.

The distances above given are measured to the head of the shoals.

(6) *Work done during the fiscal year ending June* 30, 1885.—Work commenced August 28 and closed October 31, 1884.

The operations during the season extended over 5 miles of the channel, commencing at the head of Hawk Mountain Shoal and extending nearly to the head of the shoal at Wesley's Fish Dam.

From the beginning of operations to the close of the fiscal year June 30, 1885, about 18 miles of the river between Randolph Station and Wesley's Fish Dam have been made navigable at low water for small steamers. This work covers the most dangerous shoals upon the river.

Fourteen miles of the river remain to be improved before reaching the head of steam-navigation at Brook Neal. In this distance there is one dangerous obstacle, known as White Rock Falls.

(7) *Remarks.*—The season for working in the river commences on June 1 and closes November 1.

The appropriation is made between March and August, but seldom becomes available before September 1. The working season during the fiscal year is, in consequence, reduced to two months in the fall and one month in the summer following, or three months in all.

In this period the small appropriation is wholly spent, leaving the most favorable part of the working season, between June 30 and November 1, four months, without funds to prosecute the work.

If the appropriation were larger, the work could be extended over these four months, and the progress would be doubled by the more favorable conditions.

The following appropriations have been made:

March 3, 1879	$5,000
June 14, 1880	7,500
March 3, 1881	5,000
August 2, 1882	5,000
July 5, 1884	5,000
Total	27,500
Original estimate	68,700
Appropriations to date	27,500
Amount due on estimate	41,200

Money statement.

July 1, 1884, amount available		$486 15
Amount appropriated by act approved July 5, 1884		5,000 00
		5,486 15
July 1, 1885, amount expended during fiscal year, exclusive of outsfanding liabilities July 1, 1884	$2,876 19	
July 1, 1885, outstanding liabilities	73 75	
		2,949 94
July 1, 1885, amount available		2,536 21
Amount (estimated) required for completion of existing project		41,200 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		20,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

The following letter has been received from Mr. Charles Bruce in response to a request for statistics of trade for the year 1884:

"I regret that I cannot give you an accurate estimate of the production of the valley of the Staunton, with a view to a proper presentation of the importance of another appropriation by Congress for the improvement of the navigation of the river between Randolph and Brook Neal, as the main bulk of its products is transported at great cost in wagons to several markets, and any estimate of its production must be to some extent conjectural.

"The valley, however, between Randolph and Brook Neal, is one of the most productive in Virginia, embracing a large surface of alluvion, and uplands admirably adapted to the production of tobacco.

"The equity of its claim upon the liberality of Congress rests mainly upon the fact that it is occupied and cultivated by planters who are engaged in the production of tobacco, which pays a large annual revenue to the Government in the form of a tax.

"The average cost of transporting tobacco in wagons from the Staunton River Valley to the nearest market is from 80 cents to $1 per 100 pounds, varying with the season and condition of the roads; but with the river so improved as to make steam navigation practicable at all seasons the cost will be reduced about one-half.

"With the improvement of the navigation completed to Brook Neal steamers will be substituted for wagons, and will connect with the Richmond and Danville Railroad at Randolph.

"I can positively state, from my own observation of the work already completed by the Government, and my own experience in steam navigation, that light-draught steamers will run at all seasons and without a day's interruption. Within a short time after the river shall have been made navigable by steamers it will become a new and cheap outlet to market for not less than 4,000,000 pounds of tobacco, a large amount of wheat, corn, and other farm products, and an immense quantity of valuable lumber from oak and pine forests, which have hardly been touched; and doubtless the return freights would approximate in value to the shipments which would be made from our valley.

"There cannot be any doubt that the trade on the river will be large and will constantly increase, and I regret that our present production cannot, for the reason I have given, be accurately estimated.

"CHARLES BRUCE."

K 14.

IMPROVEMENT OF THE UPPER STAUNTON RIVER, VIRGINIA (BETWEEN BROOK NEAL AND PIG RIVER).

HISTORY OF OPERATIONS.

(1) *Reference to reports.*—A report of a reconnaissance and estimates of the part of the Staunton which lies between Pig River and Brook Neal will be found in the Report of the Chief of Engineers for 1882, page 1047. A more careful examination of the part of the Staunton between Pig River and the bridge of the Virginia Midland Railroad will be found in the Report for 1883, page 827.

(2) *Description of original condition.*—The distance from Pig River to Brook Neal is about 52 miles; the descent is 221 feet, and the average fall per mile 4.3 feet. Between these points the width varies from 150 to 350 feet. The valley through which it flows is from a half to 1 mile wide. The least depth on the shoals is about four-tenths of a foot at low water, but the river is navigated by bateaux in ordinary stages.

The bottom of the river is, for the most part, of solid rock, and the gravel bars which are occasionally found no doubt rest upon rocky beds.

The freshets rise to the height of 20 to 30 feet.

The Roanoke Navigation Company, some years ago, attempted to improve the low-water stage for bateau navigation, and an improvement completed with this object would meet the present wants of trade. The country is well timbered, fairly well cultivated, and possesses unworked quarries of marble and beds of iron ore.

(3) *Plan of improvement.*—The object proposed by the improvement was to remove the obstacles to bateau navigation, by employing spur-dikes chiefly to reduce the slope of the water above, and by excavating the rock from the channel with the object of gaining depth as well as of reducing the slope.

The estimate for improving the river between Pig River and the railroad bridge, about 23½ miles, is $34,000.

The estimate for improving that part of the river between the railroad bridge and Brook Neal was based upon a reconnaissance made without instruments, and should be revised after a careful instrumental survey.

The width of the proposed channel above the railroad bridge is 14 feet, with a depth of 2 feet at low water.

(4) *Amount expended.*—Two thousand dollars were appropriated August 2, 1882, all of which sum was expended in making a cut through the rocks at Clement's Falls, just above the railroad bridge, and at Brown and Tuck's shoals, which are between 7 and 8 miles below Pig River.

(5) *Results obtained.*—The channel at Clement's Falls is now 20 feet wide and 1½ feet deep at low water.

At Brown and Tuck's shoals the channel is now about 14 feet wide, and 1½ feet deep at low water. These operations extended over a distance of about 15 miles. The total number of yards of rock removed is 535, at a cost of $2.80 per cubic yard.

The following appropriation has been made:

August 2, 1882	$2,000 00

Money statement.

July 1, 1884, amount available	$105 21
July 1, 1885, amount available	105 21

Amount (estimated) required for completion of existing project.....	$32,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	20,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

STATISTICS OF TRADE.

From 3,000,000 to 5,000,000 feet of sawed lumber, and an equal, if not greater, number of logs, have been shipped during the year; also a large quantity of barytes. By the improvement of the river, a great number of railroad-ties could be brought down.

Eight bateaux, drawing about 20 inches of water and carrying 12 tons each, make three loads per week.

From $5,000 to $6,000 judiciously spent in the river above the crossing of the Virginia Midland Railroad would increase the shipments of tobacco, wheat, corn, fruits, and other farm products.

The above statements are made by Mr. John L. Hurt, for the landing upon his farm above the crossing of the Virginia Midland Railroad.

K 15.

IMPROVEMENT OF DAN RIVER, VIRGINIA AND NORTH CAROLINA.

HISTORY OF OPERATIONS.

(1) *Reference to reports.*—The report of a survey from Danbury, N. C., to Danville, Va., will be found in the Report of the Chief of Engineers for 1879, Part I, page 652, and in the Report for 1880, Part I, page 788. The report of the survey from Danville to Clarksville will be found in the Report for 1880, page 794. A history of operations up to June 30, 1882, will be found in the Report for that year. In the Report for each of the succeeding years will be found the history of operations since that date.

(2) *History of original condition.*—The Dan River rises near Buffalo Knob, in Patrick County, Virginia. From Danbury to Danville the distance is a little more than 78 miles. The total descent in this distance is 290.65 feet, or an average of 3.727 feet per mile.

Dividing this distance into two sections at Madison, the distance from Danbury to Madison is 28.39 miles, and the descent 10.24 feet per mile, a rate of descent not to be overcome for purposes of navigation except by means of locks and dams.

From Madison to Danville the distance is 49.81 miles, and the average descent 2.82 feet per mile, a rate of descent which makes improvement possible by means of spur-dikes and rock excavation. Improvement by this means is practicable, since the descent is not concentrated at a few localities.

The river has been navigated by bateaux for 60 miles above Danville, and is still navigated as far as Madison. The obstructions consist chiefly of ledges of rock and fixed masses, occasionally bowlders and gravel.

The least depth on the ledges varies from six-tenths to one foot.

The longest and most dangerous series of rapids commences about 5.2 miles above Danville and terminates at that city. This series is called Long Shoal. The whole descent is 13.15 feet, but at one shoal (Bull Sluice) the descent is at the rate of 41 feet per mile.

Navigation is made dangerous to the boats as they approach the head of the canal at Danville by the number of rocks.

The highest flood observed during the survey occurred on January 12, 1879, when the water rose at Leaksville, 18.7 miles below Madison, to 15.65 feet above ordinary low water; at Madison, in 1850, it rose to 28.4 feet; at Wilson's Upper Ferry, the flood of 1878 rose to 16.3 feet; at Danville, just above the railroad bridge, the water rose, in 1873, to 17 feet above low water.

The rise and fall of these floods are generally too rapid to be of use to the boats navigating the river.

The width varies, as far as Madison, from 200 to 300 feet. From Madison to Danville the width varies from 300 to 1,200 feet.

The land is fairly productive, its farm products being corn, wheat, rye, oats, potatoes, fruits, and tobacco.

The valley is rich in coal and iron.

(3) *Plan of improvements.*—The channel now being excavated for bateaux is 16 feet in width and 2 feet deep at low water.

(4) *Amount expended.*—The appropriations up to July 5, 1884, amounted to $30,500.

The estimate amounted to	$52,000
Amount appropriated	30,500
Amount due on estimate	21,500

I would respectfully recommend that this amount, $21,500, be appropriated for the year ending June 30, 1887.

(5) *Results obtained up to June* 30, 1884.—The length of the channel improved above Danville, up to June 30, 1884, was 4.8 miles, leaving four-tenths of a mile, or 2,112 feet, to be cut before completing the channel to the long and deep reach of water above Long Shoal; when opened to this point a fair navigable channel for nearly 14 miles will be available. In fact, no serious obstacle is encountered until the ascending boats approach Eagle Falls, about 38½ miles above Danville.

It is proposed to make a more minute survey before beginning the improvement in this part of the river.

(6) *Work done during the fiscal year ending June* 30, 1885.—Work commenced August 25 and closed December 1, 1884.

The length of channel improved during this period was 2,130 feet, making a total of 5¼ miles (nearly) of channel completed above Danville since the beginning of the work.

The items of the season's work were as follows:

Four hundred and twenty-one cubic yards of rock excavated from channel, at $2.54 per yard. Dams II and III, just below Long Wall, were completed and sufficient rock was quarried to complete Dam I.

Seven hundred and eighty-nine cubic yards of rock were quarried and hauled to Dams I, II, and III, at a cost of 95 cents per cubic yard.

Of this amount 649 cubic yards were placed in position on the dams, and 140 cubic yards on shore ready to be hauled to complete Dam I.

Two hundred and thirty cubic yards of rock, at a cost of 36 cents per yard, were used in completing Dam G (290 feet long), which is located about 5 miles and 750 feet above Danville, near the head of a small island.

Thirty-four dollars were expended in removing loose rock, sand, and snags.

The boat, at the close of the season, was moored about 4 miles above Danville, and can be reached from Wilson's Upper Ferry.

The work of next season should be confined to completing the channel to the head of Long Shoal, and to making a survey of some of the principal shoals, including Eagle Falls.

(7) *Remarks.*—The season for working in the river commences on June 1 and closes on November 1. The appropriation is usually made between March and August, but seldom becomes available before September 1. The working season during the fiscal year is, in consequence, reduced to two months in the fall and one month in the summer following, or three months in all. In this period the small appropriation is wholly spent, leaving the most favorable part of the working season, between June 30 and November 1, four months, without funds to prosecute the work.

If the appropriations were larger, the work could be extended over these four months, and the progress would be doubled by the more favorable conditions.

Money statement.

July 1, 1884, amount available		$451 49
Amount appropriated by act approved July 5, 1884		5,000 00
		5,451 49
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$3,020 48	
July 1, 1885, outstanding liabilities	43 00	
		3,063 48
July 1, 1885, amount available		2,388 01
Amount (estimated) required for completion of existing project		21,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		21,500 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

STATISTICS OF TRADE.

No returns have been received for the year 1884. The following is taken from the report of last year:

"The total value of the trade and manufactures of Danville, Va., for the year 1881 was reported to be $8,009,206, the principal item being $5,634,351 for tobacco."

K 16.

IMPROVEMENT OF ROANOKE RIVER, NORTH CAROLINA, BELOW WELDON.

HISTORY OF OPERATIONS.

(1) *Reference to reports.*—An estimate for improving the river between Plymouth and Weldon will be found in the Report of the Chief of Engineers for the year 1872, page 726. In the Report of the Chief of Engineers for 1879, Part I, page 624, will be found a summary of operations previous to this time. Subsequent reports will be found for each year.

The report of a survey made in 1883 will be found in the Annual Report of the Chief of Engineers for 1884, page 1022.

(2) *Description of original condition.*—The Roanoke is formed by the confluence of the Dan and Staunton rivers at Clarksville, Va.; thence to Weldon the distance is 68¾ miles. From Weldon to the mouth of the Roanoke at Albemarle Sound the distance is 129½ miles. The general course of this part of the river is southeast.

Steamboats occasionally reach Weldon at high water, but Caledonia, 25 miles below, is regarded as the head of light-draught (3½ feet at low water) steam navigation. The head of heavy-draught (7½ feet at low water) steam navigation is Spring Gut Bar, about 47 miles below Weldon. This bar has a depth of 4.8 feet at extreme low water. From this point to Indian Highland, 62½ miles below Weldon, the bars have from 5 to 7 feet at extreme low water. Below Indian Highland, the depth in the channel is not less than 10 feet. The bars are composed for the most part of sand, and increase and diminish with every freshet, except perhaps Big and Little Rocky Bars, which, as their name imports, are more permanent.

The greatest obstruction to navigation is found in the snags, logs, and trees.

(3) *Plan of improvement.*—In the Report of 1872 it was proposed: (1) To remove the wrecks, logs, trees, snags, and dangerous rocks; (2) to construct longitudinal dikes at all the sand-bars.

For maintaining a channel 5 feet deep at low water, the cost was estimated at $269,000.

For maintaining a channel 8 feet deep at low water, the cost was estimated at $519,000.

The cost of removing the snags, logs, and wrecks was included in both estimates.

The construction of longitudinal dikes, the cost of which would be very heavy, was not recommended by the engineer.

In the Report of 1884, the improvement of Big and Little Rocky bars was recommended, after the removal of snags which are brought down each year by the Dan and Staunton rivers.

The present project is limited to the removal of snags, and a careful survey for the purpose of determining the best method of improving some of the bars, particularly Big and Little Rocky bars. The amount required for building the plant for removing snags and logs, and for surveying Big and Little Rocky bars, is $20,000.

(4) *Amount expended and results obtained.*—Between March, 1871, and June, 1874, $45,000 were expended in removing rocks, snags, logs, and wrecks. After a suspension of nine years, an appropriation of $5,000 was made August 2, 1882, which was expended in completing the improvement of Indian Highland Bar. This work has proved to be satisfactory.

(5) *Work done during the fiscal year ending June* 30, 1885.—No work has been done during the year.

The appropriation of $3,000, made July 5, 1884, is retained until further appropriations can be made, the sum being regarded as too small for economical work.

The river is in the collection district of Albemarle. The nearest port of entry is Edenton, N. C. The nearest light-house is Roanoke River Light, in the fifth light-house district.

Money statement.

July 1, 1884, amount available	$977 19
Amount appropriated by act approved July 5, 1884	3,000 00
	3,977 19
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	676 95
July 1, 1885, amount available	3,300 24

Amount (estimated) required for completion of existing project	$20,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	20,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

STATISTICS OF TRADE FOR 1884.

No statistics have been received giving the entire trade of the river.

Mr. Denis Simmons, of Williamston, N. C., has sent commercial statistics for that port, the totals of which are as follows:

NATURAL PRODUCTS.

Trade by water	$784,500
Trade by rail	523,000
Total	1,307,500

MANUFACTURES.

Total value of receipts	$40,000

MILLS, FACTORIES, &C.

Number	31
Amount of business	$330,000

VESSELS ENGAGED IN TRADE.

Number	8
Total tons	1,750
Greatest draught feet	8

The totals of reports for all landings during the year 1883, furnished by Mr. A. M. Walker, and published in the report of 1884, are given below:

Natural products	$10,405,500
Manufactures	4,047,000
Total	14,452,500

K 17.

IMPROVEMENT OF FRENCH BROAD RIVER, NORTH CAROLINA.

HISTORY OF OPERATIONS.

(1) *Reference to reports.*—The report and estimate for improving the part of the river between Brevard and Big Buck Shoals, in Buncombe and Henderson counties, North Carolina, will be found in the Report of the Chief of Engineers for 1878, page 525. An estimate for improving the part of the river between Smith's Bridge and the foot of Long Shoal, made in accordance with the act of August 2, 1882, will be found in the Report of the Chief of Engineers for 1883, page 832.

A history of operations, showing the progress of the improvement since 1878, will be found in the annual reports of each year. The reports of 1882 and 1883 give condensed statements of operations.

(2) *Description of original condition.*—The French Broad River rises near Caesar's Head, a spur of the Balsam Mountain, in Transylvania County, North Carolina. The general course of the part of the river now under consideration, as far as Asheville, is northeast. Its width varies from 60 feet at Wilson's Fish Trap, the proposed head of navigation, to 100, then 145, and, finally, to 340 feet at Big Buck Shoals. From the foot of Long Shoal to Smith's Bridge, near Asheville, the width varies from 570 to 330 feet. The distance from Wilson's Fish

Trap to Big Buck Shoals is 31.9 miles. The total descent is 56.59 feet. From the foot of Big Buck Shoals to the foot of Long Shoal, the distance by the profile is 4.87 miles; descent, 21.22 feet. From the foot of Long Shoal to Smith's Bridge, the distance by profile is 12.09 miles. The total distance from Wilson's Fish Trap, by the line of survey, is 48.35 miles; descent in last section, 53.13 feet. Total descent from Wilson's Fish Trap, 130.94 feet. The average depth on the shoals varies at low water from 1.7 to 2 feet.

From Wilson's Fish Trap near Brevard to Big Buck Shoals the river can be adapted to navigation by barges or light draught steamers at a small cost. To extend the improvement from Big Buck Shoals to Smith's Bridge, near Asheville, the cost will be comparatively great.

(3) *Plan of improvement.*—The first appropriations were applied to the improvement of the river between Brevard and Big Buck Shoals. After the removal of logs and trees it was proposed to construct spur dikes and to excavate a channel through the ledges of rocks which formed the bars. Under the act of August 2, 1882, appropriating $5,000, the same method of improvement was extended from Long Shoal to Smith's Bridge. The two projects were identical in their general features and contemplated making channels 35 feet wide and 2½ feet deep at low water between Brevard and Big Buck Shoals, and 30 feet wide and 2¼ feet deep from Smith's Bridge to Long Shoal.

The cost of the improvement from Wilson's Fish Trap to Big Buck Shoals was estimated at	$46,000
The cost from Long Shoal to Smith's Bridge was estimated at	76,000
Total	122,000

(4) *Amount expended and results obtained to June* 30, 1885:

Aggregate of estimates		$122,000
Expended above Big Buck Shoals	$38,000	
Expended below Long Shoal	5,000	
		43,000
Due on estimates		79,000

Of this sum about $8,000 is due on the estimate for the part of the river above Buck Shoals, and $71,000 for the part of the river between Long Shoal and Smith's Bridge.

About 26 miles of the river between Brevard and Big Buck Shoal, and 4½ miles above Smith's Bridge have been improved, making a total of 30½ miles of improved channel.

No appropriation has been made since 1882; when made, the work will be continued above or below Buck, as may be directed by Congress.

The appropriation should then be divided as follows:

From Bevard to Big Buck Shoals	$8,000
From the foot of Long Shoal to Smith's Bridge	25,000
Appropriation needed for year ending June 30, 1887	33,000

As the season is short the money should be available on June 1, 1886.

Money statement.

July 1, 1884, amount available		$211 77
July 1, 1885, amount available		211 77
Amount (estimated) required for completion of existing project	79,000 00	
Amount that can be profitably expended in fiscal year ending June 30, 1887	33,000 00	
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

STATISTICS OF TRADE FOR 1884.

The following commercial statistics have been furnished by Mr. A. Cannon:

Natural products	$66,000
Manufactures	54,000
Merchandise not included above	75,000
Total	195,000

DEAR SIR: If the Government will continue the work to Asheville the work done on the French Broad River can be utilized, and it would materially aid the development of the valley above Asheville.

If the work is stopped where it is, all is lost. The dry season has materially diminished the products of this county.

The above does not include the approximate amounts of products of the valley, but merely the amounts bought and sold above Asheville in Henderson and Transylvania counties.

A. CANNON.

The Spartansburg and Asheville Railroad connects the valley of the French Broad at Hendersonville with Charleston Harbor, South Carolina, and the western North Carolina Railroad connects Asheville with the Piedmont Air Line and with Norfolk Harbor. This line also connects the Atlantic and Ohio with the Piedmont Air Line. To these lines the river trade is tributary.

K 18.

PRELIMINARY EXAMINATION OF COCKPIT POINT, VIRGINIA, FOR ICE-HARBOR.

UNITED STATES ENGINEER OFFICE,
Washington, D. C., October 20, 1884.

GENERAL: In compliance with your order of July 31, 1884, I have the honor to report the result of a preliminary examination of Cockpit Point, Virginia, made with the object of determining whether the part of the Potomac River just below Cockpit Point is suitable for an ice-harbor for vessels navigating the Potomac River. I have visited Cockpit Point and collected the following facts, which I respectfully submit for your consideration.

During the winter months large fields of ice accumulate in the Potomac above Fort Washington. At such times ice-fields are formed over the shoals in Occoquan Bay, from High Point, on the north, to Cockpit Point about 3 miles to the south. At the same time, the ice extends lower down the river, commencing at the shoal of Chapowamsie Creek, and extending down the westerly shore to a point below Potomac Creek, nearly opposite to Maryland Point. In this part of the river, the shallowness and consequent smoothness of the water encourage the formation of ice, which is often held back by the prevailing winds for several days.

During this condition, it is not unusual to find broken or drift ice, through which vessels can pass up the main channel in deep water and in a strong tide, from Maryland Point to, or even above, Indian Head, opposite the mouth of Occoquan.

Navigation is often stopped at three points upon the river. viz, at Fort Foote, at Fort Washington, and at Glymont, which is about 6½ miles below Mount Vernon. Below these points navigation becomes insecure. Sailing vessels, at such times, always employ steam-tugs, and therefore must be classed as steamers. Steamers, finding the river im-

passible above the localities named, are compelled to retreat, and to follow the main channel until they reach a western or windward harbor where fuel can be found.

Gunsen Cove, Potomac Creek, and Occoquan Bay cannot be used as ice-harbors, for the following reasons: Ice formsat all these points almost as quickly as at Washington City; vessels can reach Alexandria at any time when they can make these harbors, and each of the harbors named will require a considerable amount of dredging to make it available for refuge in the winter season.

The prime considerations of a suitable ice-harbor on the Potomac are that it should be on the windward or westerly shore, near the main channel, and in the line of communication with fuel, supplies, and the offices of the steamboat companies.

From the above statement it may be inferred that a suitable ice-harbor must have the following conditions: (1) it must be on the western shore of the river and below Cockpit Point; (2) it must be near railway and telegraph communication with Washington City; (3) it should possess sufficient depth and expanse of water to accommodate vessels navigating the Potomac; (4) it should not require a large expenditure for dredging or for the construction of an ice-breaker.

As the site of an ice-harbor Cockpit Point fills the first and third conditions; it partly fills the second, but does not fill the fourth.

To protect the vessels which now navigate the Potomac it would be necessary to construct an ice-breaker about 2,500 feet in length and in water over 15 feet in depth. Such a structure would cost about $400,000. It is probable that a harbor can be found which can be made accessible at much less expense.

The growth of trade and the increase in the draught of vessels which navigate the Potomac will no doubt result from the improvement of the Washington Channel, now in progress of execution. This change may not occur before ten years have elapsed.

In the meantime a harbor can be found and made suitable as a refuge from ice at a moderate expenditure of money.

For these reasons I do not think that Cockpit Point is worthy of improvement as a harbor of refuge.

I have the honor to submit, herewith, a copy of a letter from Mr. C. W. Ridley, manager of the Washington Steamboat Company; also a petition of the captains and pilots of steamers navigating the Potomac.

Two charts of the Potomac River, published by the Coast and Geodetic Survey, showing the pack-ice, field-ice, and drift-ice from Washington City to Maryland Point, accompany this report.

Very respectfully, your obedient servant,

S. T. ABERT,
United States Civil Engineer.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

LETTER OF THE MANAGER OF THE WASHINGTON STEAMBOAT COMPANY.

WASHINGTON, D. C., *August* 19, 1884.

DEAR SIR: I take the liberty to address you on the subject of the proposed ice-harbor on the Potomac River, "at or near Cockpit Point," and respectfully suggest that the harbor of Quantico, Va., presents the best, if not all, the natural advantages for such a refuge, being a railway terminus, having wharves for the loading and unloading freight and passengers, and affording frequent and direct transit by rail both north and south.

Last January our own and several other river steamers were, in consequence of impassable ice-floes above, compelled to seek refuge at Quantico, where they all used the railroad facilities for transshipping passengers and perishable freight and receiving coal to enable them to resume their voyage.

The harbor presents good protection, except from ice on an ebb tide and northeast gale. We all had this experience last January, and can testify that all that is needed to make Quantico an excellent winter harbor is a short riprap breakwater at the entrance.

Very truly, yours,

C. W. RIDLEY,
Manager.

Mr. S. T. ABERT.

PETITION OF CAPTAINS AND PILOTS OF STEAMERS NAVIGATING THE POTOMAC RIVER.

We, the undersigned captains, pilots, masters, agents, and vessel owners, respectfully represent that the harbor of Quantico, at which there are railroad depots, and wharves at which freight cars can be loaded directly from vessels, and direct and frequent communication had with the city of Washington, thence to all points, is, in our opinion, the only proper and available point at which to erect the proposed breakwater to form an ice-harbor for the protection of vessels, and particularly their cargoes.

We therefore respectfully petition your Department to select the port of Quantico, Va., as the place at which the proposed ice-harbor shall be established.

Very respectfully,

Signed by—

C. W. Ridley, manager Washington Steamboat Company; Capt. J. B. Eskridge, steamer City of Washington; Capt. C. T. Entwisle, steamer City of Alexandria; Thos. Ross, sr., captain steamer Arrowsmith; Frank Phillips, pilot steamer Arrowsmith; Wm. B. Welch, general agent Potomac Steamboat Company; R. E. Tull, captain steamer George Leary; John F. Posey, pilot steamer George Leary; James N. Mannanke, second pilot steamer George Leary; George L. Sheriff, owner steamer Mattano; G. S. Jones, agent, steamer Mattano; Wm. L. Skinner, captain steamer Mattano; R. Dean, pilot steamer Mattano; Stephenson & Brother, agents steamer Sue; John T. Lewis, master tug H. H. Keys; S. F. Clements, deputy collector of customs; W. E. Condry, master schooner Clara Rahkin; Alfred Kendall, master schooner Richard Peterson; George W. Williams, master schooner Jno. A. Curtis.

Mr. S. T. ABERT.

K 19.

PRELIMINARY EXAMINATION OF COLONIAL BEACH, WESTMORELAND COUNTY, VIRGINIA.

UNITED STATES ENGINEER OFFICE,
Washington, D. C., October 20, 1884.

GENERAL: In compliance with your order of July 31, 1884, I have the honor to report the result of a preliminary examination of Colonial Beach, made with the object of determining whether the harbor is worthy of improvement.

Colonial Beach is situated upon the banks of the Potomac River, in Westmoreland County, Virginia, and is about 68 miles from Washington City.

It is the young settlement of a company chartered by the State of Virginia, January 2, 1884, with the object of establishing a summer and winter resort, chiefly for the inhabitants of Washington and Baltimore.

A portion of the tract was owned in 1797 by General Henry Lee, of Revolutionary fame. I visited Colonial Beach in the steamer Arrowsmith, and consulted several pilots, and also the secretary of the Colonial Beach Company, in regard to the wants of navigation, and compared their statements with my own observations.

From these sources I learned that the harbor is accessible in almost any state of the wind and tide for steamers of the class of the Arrowsmith, which draws about 7½ feet of water when loaded. The steamers can reach the wharf at low tide, but the mud is stirred by them for some distance in the channel. The steamers Moseley, Leary, Excelsior, and Lady of the Lake cannot land at low water.

Colonial Beach is one of the regular landings of the Potomac River boats. It is of the same kind of importance as the other landings, but differs in degree, which is in its favor.

The improvement of Nomini Creek, which formerly was closed, now permits the entrance of steamers which ply on the Potomac River and the Chesapeake Bay. Leonardtown, at the head of Breton Bay, has been made, by improvement, accessible to the same boats.

Colonial Beach is in some respects more important than either of the localities above named. During the past season, 15,000 passengers have been landed at the wharf. The books of the steamer Arrowsmith showed the number of 7,000 passengers.

Besides being a summer and winter resort, it possesses a trade which is growing. It is a shipping point for oysters and fish for the Washington market. For these reasons I think Colonial Beach worthy of improvement.

In order to make the survey, to prepare the maps, project, estimate, and to make the required report, $300 will be necessary.

A copy of a letter from Samuel Norment, vice-president of the "Inland and Seaboard Coasting Company," is respectfully submitted. Tracings of the original chart, exhibiting the results of an examination made by the Coast and Geodetic Survey, have been obtained, but will be reserved to accompany any further report.

Very respectfully, your obedient servant,

S. T. ABERT,
United States Civil Engineer.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

LETTER OF THE VICE-PRESIDENT OF THE INLAND AND SEABOARD COASTING COMPANY.

WASHINGTON, D. C., *October* 6, 1884.

DEAR SIR: I have to respectfully call your attention to the necessity of having the way open to Colonial Beach Wharf by a small outlay for dredging, if it is expected that our Norfolk steamers are to stop there, and it is getting to be a place of such importance that it is quite desirable that they should stop.

We hope you will give this matter consideration, as at the present time it is impossible for anything but light-draught boats to stop at the wharf in question.

Very respectfully,

SAML. NORMENT.

Mr. S. T. ABERT,
United States Civil Engineer.

SURVEY OF COLONIAL BEACH, WESTMORELAND COUNTY, VIRGINIA.

UNITED STATES ENGINEER OFFICE,
Washington, D. C., January 30, 1885.

GENERAL: I have the honor to submit the following report of a survey of the harbor or approach to the landing at Colonial Beach, formerly known as White Point, in Westmoreland County, Virginia.

This survey was directed to be made in the river and harbor act of July 5, 1884, and was assigned to me by your letter of November 21 of the same year.

In a preliminary report submitted by me October 21, 1884, the reasons are given for thinking the harbor of Colonial Beach to be worthy of improvement by Government. In the same report will be found a short account of the locality and a statement of the facts which show its commercial importance as one of the landings of the steamers which trade on the waters of the Potomac River and Chesapeake Bay.

During the past year Colonial Beach, although recently established as a summer resort, was visited by 15,000 persons. Its situation is accessible to Baltimore and Washington by steamboat.

It will be found upon the map of Potomac River, between Rosier's Creek and Mattox Creek, on the Potomac, about 68 miles below Washington.

Steamers drawing 7½ feet can now land at the wharf, but shippers and citizens holding property at this point desire such an improvement of the channel as will permit the landing of vessels drawing from 12 to 15 feet.

The estimate given below is based upon a proposed cut, which will have 300 feet width by 16 feet depth at low water.

The length of the wharf is 433 feet. From the end of the wharf to the 15-foot curve is 2,050 feet; from the same point to the 18-foot curve is about 3,800 feet.

From the center of gravity of the cut to the center of gravity of the dumping ground is about 1½ miles. The depth on the dumping ground is 7 feet at low water. The range of the tide is 1.4 feet. A tide-gauge was nailed to the seventh pile from the extreme end on the north side of the wharf. Six galvanized nails, driven horizontally into the pile, correspond to the sixth foot above low water.

The surface of the bottom is composed of sand near the wharf, and for the greater part of the distance between the wharf and the 15-foot curve the sounding-lead indicated mud, with occasional patches of oyster shells.

When this crust is penetrated a blue mud is found, which in some places is very soft, and for this reason the width of the proposed channel has been made 300 feet.

Twenty per cent. for the same reason should also be added to the estimate of the number of cubic yards of material to be taken from the channel. Before the work is offered for contract, and in order to determine the composition of the bottom accurately, borings should be taken along the line of the cut to the depth of 17 feet below low water.

At a point about 2,150 feet above the wharf the 15-foot curve reaches much nearer to the shore. The cost of dredging a channel at this point would be about one-fourth the cost of dredging a channel at the wharf. But the northwest winds make a landing at this point dangerous in the winter season, and the improvement at the site of the present wharf is therefore recommended. The estimate submitted is, therefore, made for cutting a channel to the present wharf.

A channel 16 feet deep and 300 feet wide, with a turning basin about 400 feet square, will have the following cubic contents and cost:

	Cubic yards.
Channel and basin	75,200
Add 20 per cent. for reflow	15,040
Total	90,240

At 20 cents per yard	$18,048 00
Add 15 per cent. for contingencies	2,707 20
Total	20,755 20
Or, in round numbers	20,800 00

Very respectfully, your obedient servant,

S. T. ABERT,
United States Civil Engineer.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS, U. S. ARMY,
February 6, 1885.

Respectfully returned to Mr. S. T. Abert for revision.

The improvement by dredging does not seem to be correctly located and must probably soon fill. The position of the proposed cut should be further investigated.

By command of Brig. Gen. Newton.

JOHN G. PARKE,
Colonel of Engineers, Bvt. Maj. Gen., U. S. A.

[Second indorsement.]

UNITED STATES ENGINEER OFFICE,
Washington, February 19, 1885.

Respectfully returned to the Chief of Engineers, U. S. Army, with report and charts.

S. T. ABERT,
United States Civil Engineer.

SUPPLEMENTAL REPORT.

UNITED STATES ENGINEER OFFICE,
Washington, D. C., February 19, 1885.

GENERAL: In compliance with your order of February 6, 1885, I have revised the location and estimate of the proposed cut from the 15-foot curve to the wharf at Colonial Beach, and I have the honor to submit the following report:

The wharf at Colonial Beach may be approached in three directions, in each of which it is practicable to dredge a channel at a moderate cost. These are: First, in the direction A B; second, in the direction B C; third, in the direction B D.

The selection of the best position for the cut depends upon the effect of the winds upon vessels arriving and departing, and upon the movement of silt and sand upon the submerged beach in front of the shore.

EFFECT OF WINDS.

The movement of vessels is hindered by winds chiefly from the northwest and from the east and east-southeast. A point of land above affords partial shelter from the northwest winds, the effect of which is still further reduced by the long shallow beach over which it must pass.

The winds from the east and east-southeast approach the wharf without hindrance.

Coming across the Potomac, which is here from 3 to 25 miles in width, these winds fall upon the beach with great force. A vessel can approach and depart in these directions with less obstruction than when the winds blow across its course. A vessel approaching or departing in a north or northeast direction encounters this difficulty, and is in danger of being blown on shore.

MOVEMENT OF SILT AND SAND.

In order to determine the movement of silt and sand, in summer and winter, it will be necessary to make observations at intervals during the year.

Observations extending over so long a period are not practicable, and indeed are not necessary.

Captains of steamers were consulted, also pilots, fishermen, and farmers who live near the beach.

No evidence could be discovered of the serious movement of sand and silt beneath the water and above and below the wharf. Fishermen who spread their nets upon poles along the front have observed no deposit in the vicinity. The Coast Survey chart, made in 1862, shows no material change of depth in twenty-four years. If Rozier's Creek, which is above, and Mattox Creek, which is below, contribute anything to the river, a small quantity is deposited in front of Colonial Beach. It seems probable that, if any sediment is held in suspension or is rolled along the bottom, it will obey the major force, and be brought upon the beach by the east and east-southeast winds.

The currents of ebb and flood tide seem to exhibit little power of transporting material. The chart prepared under my direction, when compared with that of the Coast Survey made in 1862, confirms the above conclusions.

These conclusions can now be applied in order to determine the best direction for the proposed cut to the wharf. The following references will be understood by an inspection of the accompanying chart:

1. A cut upon the line A B will not be exposed to the northwest winds, but will be open to the winds from the east and east-southeast, one of which has a sweep of 25 miles. Vessels will, therefore, be greatly hindered in leaving and approaching upon this line.

2. A cut upon the line B C will be exposed to the northwest winds, which are partially broken. Vessels will not be so greatly hindered as they will be in approaching by the line A B.

3. A cut by the line B D is nearly as favorable as that by the line B C, but lumps will be encountered before reaching deep water.

Finally, it may be said that approaching and leaving the end of cut B C vessels can take the usual magnetic course from Cedar Point above and Cobb's Point Light below.

I therefore think the line B C would be the best direction for the proposed cut.

This line is adopted in my report of January 30, 1885.

Very respectfully, your obedient servant,

S. T. ABERT,
United States Civil Engineer.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

APPENDIX L.

IMPROVEMENT OF THE HARBOR AT NORFOLK, VIRGINIA; APPROACH TO NORFOLK HARBOR, VIRGINIA; CURRITUCK SOUND, COANJOK AND EDENTON BAYS, AND NORTH RIVER BAR, NORTH CAROLINA—IMPROVEMENT OF CERTAIN RIVERS IN VIRGINIA AND NORTH CAROLINA.

REPORT OF CAPTAIN F. A. HINMAN, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1885, *WITH OTHER DOCUMENTS RELATING TO THE WORKS.*

IMPROVEMENTS.

1. Harbor at Norfolk, Virginia.
2. Approach to Norfolk Harbor and the United States (Norfolk) Navy-Yard, between Lambert's Point and Fort Norfolk, Virginia.
3. Appomattox River, Virginia.
4. Nottoway River, Virginia.
5. Blackwater River, Virginia.
6. Archer's Hope River, Virginia.
7. North Landing River, Virginia and North Carolina.
8. Edenton Bay, North Carolina.
9. Currituck Sound, Coanjok Bay, and North River Bar, North Carolina.
10. Meherrin River, North Carolina.
11. Pamplico and Tar rivers, North Carolina.
12. Yadkin River, North Carolina.
13. Scuppernong River, North Carolina.
14. Removing sunken vessels or craft obstructing or endangering navigation.

EXAMINATIONS AND SURVEYS.

15. Perquiman's River above Hartford [Hertford], North Carolina.
16. Green River, North Carolina.
17. Pasquotank River, North Carolina, above mouth of canal.
18. Cashie River, from its mouth to the town of Windsor, in Bertie County, North Carolina.

UNITED STATES ENGINEER OFFICE,
Norfolk, Va., July 25, 1885.

GENERAL: I have the honor to transmit herewith my annual report upon the works of river and harbor improvement in my charge for the fiscal year ending June 30, 1885.

Very respectfully, your obedient servant,

F. A. HINMAN,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.
(Through Lieut. Col. W. P. Craighill, Corps of Engineers.)

L 1.

IMPROVEMENT OF HARBOR AT NORFOLK, VIRGINIA.

The act of July 5, 1884, appropriated $25,000 for this work. A project for the expenditure thereof was submitted to the Chief of Engineers and duly approved.

In accordance therewith proposals were invited for dredging, and on November 3, 1884, a contract was entered into with the National Dredging Company, the lowest bidder, to do the work at 17½ cents per cubic yard measured in place.

Work was to have been commenced under the contract on or before December 1, 1884, and finished by June 1, 1885. The company began work November 29, 1884, and completed it January 15, 1885, removing 88,538 cubic yards of material from the Eastern Branch and 27,861 from the Southern Branch, or a total of 116,399 cubic yards.

The work in the Eastern Branch was through the bar at the mouth, and resulted in a channel at least 22 feet deep and at least 200 feet wide at mean low water from the Norfolk and Western Railroad Bridge down to the mouth. That done in the Southern Branch widened the channel on either side, making it at least 25 feet deep, and at least 200 feet wide at same stage, from the navy-yard to the mouth, with the exception noted below.

A survey was made in March and April of the harbor from Fort Norfolk to the United States navy-yard on the Southern Branch, and to Campostella Bridge over the Eastern Branch, and a map of same drawn on a scale of $\frac{1}{3600}$. The adopted Port Warden Lines aggregate 46,416 feet in length.

The 25-foot channel has narrowed a little; at the mouth of the Southern Branch it has shoaled to 24 feet for a distance of 700 feet. An inspection of the accompanying map of the Eastern Branch, in connection with the communications referred to herein, will best describe its condition and wants.

The superintendent of the Norfolk and Western Railroad has intimated (July 16) that the company will remove the stone abutment to the county bridge.

The portion of the approach to the harbor between Lambert's Point and Fort Norfolk is not included herein, as it is now a work by itself.

The following allotments have been made from appropriations for the work specified below for building a suitable steam tender to replace one that has been chartered for a number of years past for use on said works:

Approach to Norfolk Harbor, Virginia	$3,000
Harbor at Norfolk and its approaches, Virginia	2,000
Currituck Sound, Coanjok Bay, and North River Bar, North Carolina	1,500
North Landing River, Virginia and North Carolina	1,500

Plans and specifications have been prepared for this tender, which will be built in due time.

I append hereto copies of my reports to the Chief of Engineers as follows:

(1) Report dated September 1, 1884, relative to building a dike in this harbor.

* * * * * * *

(4) Report of July 9, 1885, relative to the general improvement of this harbor and its approaches, with estimates therefor.

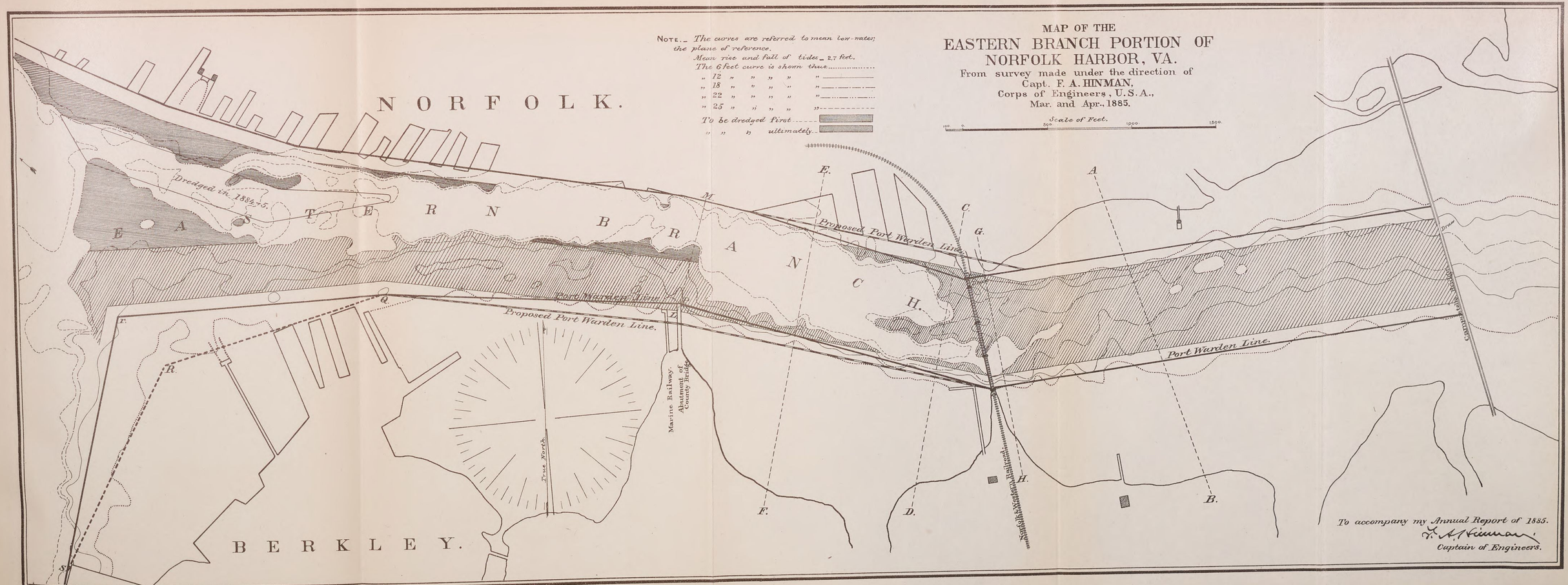
From a business point of view Norfolk may be said to be an important port of North Carolina as well as of Virginia, as a large portion, if not the larger portion, of the trade of the former seeks it.

MAP OF THE EASTERN BRANCH PORTION OF NORFOLK HARBOR, VA.

From survey made under the direction of
Capt. F. A. HINMAN,
Corps of Engineers, U.S.A.,
Mar. and Apr., 1885.

Scale of Feet. 500 0 1000 1500

NOTE.— The curves are referred to mean low water; the plane of reference.
Mean rise and full of tides = 2.7 feet.
The 6 feet curve is shown thus .....
" 12 " " " " "
" 18 " " " " "
" 22 " " " " "
" 25 " " " " "
To be dredged first
" " " ultimately



To accompany my Annual Report of 1885.

F. A. Hinman
Captain of Engineers.

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The commerce of Norfolk and vicinity has grown largely during the past year. A new short line to New York was completed, called the New York, Philadelphia and Norfolk Railroad, thus making five commercial railroads centering here, besides the two railroads to the summer resorts at Ocean View and Virginia Beach.

The new coaling station at Lambert's Point is bound to take high rank among those of the world, and attention is invited to the coal statistics appended hereto.

Lines of steamers run regularly from Norfolk to Richmond, Baltimore, Philadelphia, New York, Providence, Boston, and various ports of North Carolina. It would be difficult to obtain the statistics relative to the enormous coastwise trade in truck, oysters, peanuts, &c. The statistics relative to exports, imports, &c., obtained from the collector of the port, as well as those pertaining to cotton, are appended hereto.

Norfolk is a port of entry.

Money statement.

July 1, 1884, amount available		$3,152 14
Amount appropriated by act approved July 5, 1884		25,000 00
		28,152 14
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$26,148 23	
July 1, 1885, outstanding liabilities	2 97	
		26,151 20
July 1, 1885, amount available		2,000 94
Amount that can be profitably expended in fiscal year ending June 30, 1887 Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		507,744 56

Abstract of proposals received for furnishing and delivering a steam-launch, opened by Capt. F. A. Hinman, Corps of Engineers, at Norfolk, Va., September 22, 1884.

No.	Names and addresses of bidders.	Date of delivery.	Name of boat.	Price.
1	Edward E. Roberts, Red Bank, N. J	On or before October 10, 1884.	Zingara	$5,300
2	William R. Osborn, Peekskill, N. Y		Zephyr	5,900
3	S. B. Greacen, Perth Amboy, N. J		Hessie	8,650
4	Thomas Manning, 53 Beaver street, agent for Jacob Lorillard, owner of Venture, 65 South street, New York, N. Y.		Venture	6,500
5	Samuel Holmes, New York, N. Y		Alberta, M	10,500
			Bartholdi	4,450
			Edwin A. Hayes	4,750
			F. E. Pinto	3,500
6	William E. Woodall & Co., Baltimore, Md.			8,000

All bids rejected, no steam-launch being suitable.

Abstract of proposals received for dredging in Norfolk Harbor, Va., opened by Capt. F. A. Hinman, Corps of Engineers, at Norfolk, Va., October 24, 1884.

No.	Names and addresses of bidders.	Number and kind of machines to be used.	Capacity.	Proposed time for commencement and completion of work.	Price per cubic yard.
					Cents.
1	National Dredging Company, Wilmington, Del.	Requisite appliances.	.....	To complete the work on or before April 15, 1885.	17½
2	H. E. Culpepper, Portsmouth, Va.	One or more of Osgood's patent dredges.	400 cubic yards per day each.	Begin work on or before December 1, 1884, and complete same on or before June 1, 1885.	19½
3	Morris & Cumings Dredging Company, New York, N. Y.	One or more dredging machines.	About 1,000 cubic yards per day.	.....	20
4	James Caler & Son, Norfolk, Va.	One or more dipper dredges.	300 cubic yards per day.	Begin work on or before March 1, 1885, and complete same on or before October 10, 1885.	18
5	Atlantic Dredging Company, Brooklyn, N. Y.	.....	.....	.....	19 7/10
6	American Dredging Company, Philadelphia, Pa.	All necessary appliances.	.....	Begin work on or before January 1, 1885, and complete same on or before June 30, 1885.	21
7	George C. Fobes & Co., Baltimore, Md.	One or more grapple dredges.	.....	Begin work between December 1 and 25, 1884, and complete same on or before June 1, 1885.	18¾
8	New York Steam Dredging Company, New York, N. Y.	One clam-shell dredge, or two if necessary.	.....	Begin work on or before December 15, 1884, and complete same on or before June 30, 1885.	20
9	P. Sanford Ross, Jersey City, N. J.	One large clam-shell dredge.	.....	Begin work on or before December 1, 1884, and complete same on or before June 1, 1885.	17⅝

Contract with National Dredging Company.

Commercial statistics for port of Norfolk from July 1, 1884, to June 30, 1885.

Direction.	Vessels cleared.		Vessels entered.	
	Number.	Tonnage.	Number.	Tonnage.
Foreign	127	102, 821	66	70, 711
Coastwise	1, 450	1, 275, 477	1, 330	1, 078, 484
Total	1, 577	1, 378, 298	1, 396	1, 149, 195

IMPORTS AND EXPORTS.

Imports.	Value.	Exports.	Value.
Guano	$84, 566 12	295,817 bales cotton	$14, 278, 835
Salt	28, 652 45	4,666,870 staves	258, 328
Coal	680 00	Coal	22, 626
Potatoes	1, 030 00	Shingles	11, 509
Cotton-ties	6, 788 77	Hogsheads tobacco	53, 675
Kainit	3, 022 60	Manganese	28, 585
Goat-skins	2, 265 00	Bark	10, 292
Sundries	1, 367 39	Lumber and logs	109, 934
		Corn	11, 850
		Sundries	11, 412
Total	128, 372 33	Total	14, 797, 046

JNO. VERMILLION,
Marine Clerk, United States Customs Office, Norfolk, Va.

LETTER OF THE NORFOLK AND PORTSMOUTH COTTON EXCHANGE.

NORFOLK AND PORTSMOUTH COTTON EXCHANGE,
Norfolk, Va., July 14, 1885.

DEAR SIR: I take pleasure in submitting herewith statement of the receipts and shipments of cotton at this port for the twelve months ending June 30, 1885:

RECEIPTS.

	Bales.
Received at Norfolk twelve months ending June 30, 1885	557,397

SHIPMENTS.

Direct to Great Britain	277,667
Direct to France	6,375
Direct to Continent	11,775
Total direct foreign shipments	295,817
Total coastwise ports	257,325
Total twelve months	553,142

I remain, dear sir, yours, very truly,

NORMAN BELL,
Superintendent and Secretary.

Capt. F. A. HINMAN,
Corps of Engineers, U. S. A.

SHIPMENT OF POCAHONTAS SEMI-BITUMINOUS COAL FROM JULY 1, 1884, TO JUNE 30, 1885

	Tons.
September, 1884	1,572
October, 1884	7,615
November, 1884	4,000
December, 1884	6,042
January, 1885	6,489
February, 1885	7,639
March, 1885	24,484
April, 1885	31,251
May, 1885	28,951
June, 1885	28,590
Total	146,633

Norfolk, Va., June 30, 1885.

WILLIAM LAMB & CO.,
Agents of Castner & Co., Limited.

Capt. F. A. HINMAN,
Corps of Engineers, U. S. A.

LETTERS OF CAPTAIN F. A. HINMAN, CORPS OF ENGINEERS.

1.

UNITED STATES ENGINEER OFFICE,
Norfolk, Va., September 1, 1884.

GENERAL: In accordance with your instructions of the 12th ultimo, on my project and my supplementary project of July 21 and 30, respectively, for the expenditure of the sum of $25,000, appropriated by the act of July 5, 1884, for improving harbor at Norfolk, Va., and its approaches, I have the honor to submit the following:

As directed, I have compared the charts showing the condition of the harbor before and after improvement to see how far the results obtained by dredging have been maintained.

The accompanying map* of the latest general survey (1882), to which reference is made herein, shows the areas dredged from time to time, the dates when dredged, and also the surveys made to date of portions of the locality under consideration. Each area will now be described in detail.

The bar at the mouth of the Eastern Branch was dredged to a depth of 22 feet at mean low water from 1877 to 1879, inclusive. Berkley Flats forms one side of the Eastern Branch at this point. It will be observed that considerable shoaling has occurred since the dredging.

In the Southern Branch dredging to a depth of 25 feet at mean low water was done from 1879 to 1883, inclusive, some of it being desultory, necessitated by the presence of lumps which were found to be due to sunken logs, of which a large number have been removed. On the west side of Berkley Flats, and also on both sides of the river near the mouth, the dredging was done regularly, and comparison shows it to be quite permanent.

Portsmouth Flats, a short distance below the mouth of the Southern Branch, was dredged in 1880 to a depth of 22 feet at mean low water, and comparison shows that there has been but little, if any, filling since the work was done.

A little dredging was done in 1879 in the vicinity of Town Point, at the time the wharves were drawn in as recommended by the United States Advisory Board, but as it was small in extent and consisted principally in tearing up the old wharves by a powerful grapple-machine, it was not located on the map. At the same time dredging was done in this vicinity by the wharf owners (who should see to this in future, if necessary) to a depth of 25 feet and over at mean low water.

Dredging was done from 1881 to 1883, inclusive, from the county bridge, formerly over the Eastern Branch, nearly up to the bridge of the Norfolk and Western Railroad Company, to a depth of 25 feet at mean low water; as only a short time has elapsed since this was completed and an examination made, there are no means of comparison to determine whether or not the dredged area has deteriorated. The same may be said of the dredging in the harbor immediately below Town Point, done in 1883, to a depth of 25 feet at mean low water. At this latter locality two wrecks, one a vessel of considerable size, were removed.

From the foregoing it appears, so far as comparison can be made, that with the exception of the bar at the mouth of Eastern Branch the dredged areas have deteriorated but slightly, if at all.

In regard to the bar at the mouth of Eastern Branch, the deterioration is very marked. In reference to it I quote as follows, from reports specified below:

[Report of Capt. C. B. Phillips, Corps of Engineers. Report of Chief of Engineers, 1872, page 722.]

* * * We find slight and rather peculiar changes in the bed of the harbor between the county bridge across the Eastern Branch and the confluence of the two branches. We find a slight tendency of the channel to deepen immediately and for some little distance below the bridge.

Further down (some 800 yards below the bridge) shoaler water, which, so far as is known has always existed, is encountered, and continues until the influence of the Southern Branch is felt. The depth of the shoaler water referred to has changed but little since the soundings were taken by the Coast Survey. It appears to have filled in very slightly. Its worst feature seems to be that the shoal is slowly extending along to the wharves immediately below the ferry. I attribute these changes to the existence of the county bridge across the Eastern Branch. The stream is considerably

* Omitted.

contracted at this point by a long causeway, which constitutes the southern extremity of the bridge.

This accounts, in my opinion, for the slight deepening immediately below the bridge, and also for the slight additional shoaling below, the removed material being deposited as soon as the wider portion of the stream is reached.

It will be perceived that a considerable deepening has taken place immediately at the confluence of the two branches. This would seem to be but the mere result of the changes just referred to, the gradual extension of the shoaler water near the ferry seeming to contract the width of the Southern Branch channel, and causing it to make deeper water.

From this point on towards the entrance of the harbor, and also in following up the course of the Southern Branch, the water in the channel seems to have pretty generally maintained its original depth. * * *

[Report dated February 15, 1875, of Mr. S. T. Abert, United States Civil Engineer. Report Chief of Engineers, 1875, Part II, pages 146, 147.]

THE BAR.

The Elizabeth River is formed by two branches, known as the Southern and the Eastern Branch. The first, on account of the greater length and volume of its water, generally takes the name of the river. The bar is formed at the mouth of the Eastern Branch, extending from a point opposite the ferry at the foot of Market Street Square to 750 feet above and 150 feet below, measured on the axis of its channel; or, if measured 150 feet from the wharves, and parallel with them, it extends 900 feet above the ferry and 1,200 below, manifesting a decided tendency to shoal along the wharves. It may be regarded as being formed by two combinations of forces, one combination causing the shoaling along the front of the wharves, the other giving rise to the bar which lies farther out in the channel. The shoaling I regard as due to the deflection of the ebb at the upper part of the wharves, more particularly by the Old Dominion, Cromwell, Graves, and the railroad wharves, and by the retardation of the current along the entire wharf-front. The bar, which occupies the main channel, is partly due to the county bridge, 800 yards above, and in a large degree to the angle of confluence of the Southern Branch. The two branches of the river meet at an obtuse angle, giving rise to opposing currents at ebb tide, the greatest of which holds its way, while the lesser branch is retarded, causing a deposit of the material held in suspension or rolled along the bottom.

The Southern Branch has greater length, larger tributaries, and consequently greater tidal capacity. Just above the point of confluence it is contracted to nearly one-half the average width of the Eastern Branch. These conditions increase the predominance of the river, and confine the bar to its present position within the mouth of the Eastern Branch. The flood seems to exert some influence, but the exact nature of it cannot be determined without careful measurement of sub-surface velocities. As has been stated, the two branches meet with opposing currents. The confluence should be at an acute angle, and the work to effect this result must involve considerable expense. To accomplish this change it would be necessary to rectify the wharf-front of the city of Portsmouth, commencing at the southern point and extending 1,200 feet above, pushing the entire front back until at the southern point it will be about 300 feet in the rear of its present position. The line should then be continued by dredging from the point of the wharf to the 25-foot curve of depth, turning on a gentle curvature to the left hand. Between this line and the channel the material should be dredged to a depth of 20 feet.

These operations involve an interference with riparian rights and require a large amount of dredging. I regard them, however, as essential parts of any plan for the correction of the forces which co-operate to form the bar. As it is probable that the depth required may be obtained by operations conducted within the Eastern Branch, the complex questions involved in making any change in the mouth of the Southern Branch may for the present be left out of consideration. This omission may not conduce to the permanence which might otherwise be obtained, but it is possible to attain by other means a depth which may endure sufficiently long to add enormously to the commercial facilities of the harbor.

The county bridge over the Eastern Branch has the effect of increasing the velocity of the current, which takes up its load at the bridge and deposits it as the stream expands on the bar below. For the same reason any material in suspension is deposited on the bar.

This bridge is owned by private parties, who, I have been informed, are willing to sell it, and the city authorities have taken the preliminary steps for its purchase and removal. In order to benefit the harbor to the fullest extent the causeway should be removed at the same time as the bridge.

* * * * * * *

[Report dated January 27, 1877, of the United States Advisory Board to the Harbor Commissioners of Norfolk and Portsmouth, Va.]

* * * Within the location of our Port Warden Line, between H and K, the general characteristics are sluggishness of the currents and a disposition to shoal up. For a considerable distance we have 1 to 3 feet less water along this frontage than there was twenty years ago.

From K to L our line crosses several wharves which project unduly into the stream. The necessity for carrying our line thus within existing structures appeared absolute when we inspected Mr. Weir's current observations in this neighborhood. There is a natural disposition of the ebb current to press upon the frontage, and this disposition cannot be changed by any practicable means. The best that we could do was to provide for the removal of all salients from the general line of frontage, so that the current may sweep past without meeting resistances which consume its *vis viva* or turn it off into too sharp conflict beyond with the outflow of the Southern Branch. It is in this neighborhood that the current from the Eastern Branch issues from the natural confinement of its banks and begins to lose velocity and depth. * * *

Since the foregoing was written, the county bridge referred to has been purchased by the Norfolk and Western Railroad Company and removed in 1881, but the Southern abutment still exists.

Attention is invited to the Port Warden Lines recommended for Berkley Flats, indicated on the map, and in this connection I quote from the report of the United States Advisory Board, dated February 21, 1877:

* * * The point P has been located at the outer end of the southern abutment of the Toll Bridge, as a convenient starting point. This abutment projecting far out into the river would not have been approved as a new project, but may be tolerated as an old one.

* * * * * * *

Our principal anxiety in the adjustment of the Berkley line has been experienced in the location of a point near the bifurcation of the flood-current between the Eastern and Southern branches. The point *r* is physically the best that can be assigned, but it lies far out from the land, and falls in a favorite anchorage-ground for small vessels. It is also objectionable for the reason that unless the frontage could be carried out to the lines on either side simultaneously (which is impracticable), eddies would be created which would change the configuration of the shoal to the injury of the channels. We have decided, therefore, to recommend that the lines Q to *r* and *r* to S should be adopted as the ultimate limit of uniform structures, but that the interior lines Q to R and R to S should be provisionally established. Within these provisional lines irregular structures would be harmless, there being only sluggish movements over the larger part of this space.

The channel through the bar at the mouth of the Western Branch was dredged to a depth of 25 feet at mean low water from 1878 to 1880, inclusive. Its location is shown on the map.* This portion is now being examined, in compliance with your indorsement of the 12th ultimo, on my project of July 21, 1884, for the expenditure of the sum of $50,000, appropriated by the act of July 5, 1884, for improving approach to Norfolk Harbor and the United States (Norfolk) navy-yard. A Board has been ordered to report on it.

The cut through Sewell's Point Bar was only completed quite recently.

In view of the foregoing, it is thought that the shoaling at the mouth of Eastern Branch is very largely due to natural causes that will always exist, aided heretofore by the county bridge, a part of which has been removed, as stated, leaving the southern abutment, *which should also be removed.* There are no means of ascertaining the amount of deterioration due specifically to this bridge. It is quite impracticable now to discharge the Eastern Branch into the Southern Branch at a proper acute angle to prevent the formation of a bar. Dikes for this purpose would probably not be permitted under any circumstances, as they would obstruct the harbor greatly, especially the ferry. Periodical dredging to a small extent will therefore be necessary. This will most likely be less-

*Omitted.

ened as the flats are dredged and the Berkley shore protected by wharves. It is possible considerable of the material forming the bar at the mouth of Eastern Branch has washed down from Berkley Flats, and it is more than probable that stirring up the bed of the river above by dredging has caused a more rapid formation of the bar by the deposit of material thereon so stirred up than would have been produced otherwise.

In conclusion, no dikes or jetties are required, and dredging alone is recommended as provided for in the said project of July 30 last, for improving harbor at Norfolk, Va., and its approaches.

Very respectfully, your obedient servant,

F. A. HINMAN,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.
(Through Lieut. Col. W. P. Craighill, Corps of Engineers.)

2.

UNITED STATES ENGINEER OFFICE,
Norfolk, Va., July 9, 1885.

GENERAL: In accordance with your indorsement of September 13 last on my project of July 21, July 30, and September 1 last, relative to the expenditure of the amount appropriated by the act of July 5, 1884, for improving harbor at Norfolk, and its approaches, Va., I have the honor to submit the following "plan, without regard to cost for the rectification of the Eastern and Southern branches, such as would cure present evils, with a view to comparison of that method of treatment, considering its cost, its advantages and disadvantages, with the method of dredging annually, or as often as may be necessary," in said harbor and approaches, and incidentally, in connection therewith, a project for the general improvement of the harbor and its approaches.

I respectfully transmit herewith (1) tracing* of map of my recent survey of said harbor; (2) tracing* of map of my survey of last year of dredged channel through Sewell's Point Bar; (3) Coast Survey map* of Sewell's Point and vicinity; (4) three tracings* of maps of a portion of said harbor relative to tidal currents, prepared in 1876 by the Coast Survey for the Board of Harbor Commissioners of Norfolk and Portsmouth, Va.; and (5) copy of report* of the United States Advisory Board relative to the latter.

It is thought that the Port Warden Lines are all well located, for the reasons given by the Advisory Board, with the exception of those in the vicinity of the railroad bridge over the Eastern Branch. I have shown in broken red lines on the accompanying map the changes I would make in them, thereby cutting off 120 feet of the solid stone abutment of the old county bridge (removed) and extending the said railroad bridge 140 feet to obtain greater sectional area through this reach.

I have heretofore reported fully relative to removing this abutment, and also on desired modifications of the Norfolk and Western Railroad bridges over the Eastern and Southern branches. Of course the welfare of the harbor demands these, so that the tidal flow will be free and the tidal reservoirs above allowed to fill to their maximum capacities, in order that the tidal currents may perform their proper functions in maintaining the channels.

It is understood, from a recent opinion of the honorable the Attorney-

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* Omitted.

General, that the foregoing very desirable modifications cannot be ordered by the United States without authority from Congress, but that other parties could compel the owners thereof to make them.

As these bridges as now constructed are allowed to remain so by permission of said Board of Harbor Commissioners, would it not be well to abandon the Eastern Branch entirely? Of course the balance must be adhered to, as the navy-yard is in question.

There is no reliable data to show the rate of fill in the Eastern Branch, as a large amount of dredging has been done in it at various times, at different places, and to different depths; in fact, desultory dredging has been done there. The present 22-foot channel below the Old Dominion Steamship Company's wharves was dredged only last winter to a width of about 210 feet.

Dredging is proposed as shown on the accompanying tracing and as specified in the following table, the cost being put at 22 cents per cubic yard measured in place. (It is here remarked that the channel across Sewell's Point Bar is reported to have been dredged to a depth of 25 feet and a width of 200 feet at mean low water in 1882–'83. The accompanying map* shows that it has since shoaled very peculiarly.)

Location.	Temporary channel.	500-foot channel.	Cost.	Ultimate channel.	Cost.	Total.	Total cost.
Elizabeth River:	*Cubic yards.*	*Cubic yards.*		*Cubic yards.*		*Cubic yards.*	
From Fort Norfolk to Hospital Point	.....	10,175	$2,238 50	427,720	$94,098 40	437,895	$96,336 90
From Hospital Point to its head; Portsmouth side	.....	.....	.....	197,580	43,467 60	197,580	43,467 60
Southern Branch:							
From its mouth to upper end of navy-yard	.....	248,300	54,626 00	.....	.....	248,300	54,626 00
From its mouth to upper end of navy-yard; Berkley side	.....	.....	.....	31,000	6,820 00	31,000	6,820 00
Eastern Branch:							
From its mouth to Norfolk and Western Railroad Bridge	57,350	.....	12,617 00	.....	.....	57,350	12,617 00
From its mouth to Norfolk and Western Railroad Bridge; Berkley side	.....	.....	.....	381,060	83,833 20	381,060	83,833 20
From bar just below to Norfolk and Western Railroad Bridge	12,580	.....	2,767 60	.....	.....	12,580	2,767 60
From Norfolk and Western Railroad Bridge to Compostella Bridge	.....	.....	.....	335,590	73,829 80	335,590	73,829 80
Elizabeth River from Sewell's Point Bar	.....	504,073	110,896 06	.....	.....	504,073	110,896 06
Total	69,930	762,548	183,145 16	1,372,950	302,049 00	2,205,428	485,194 16

It is manifest that no bulkhead is required along the Portsmouth Flats, as the channel there maintains itself very well. It was never dredged below 22 feet at mean low water. A bulkhead would be desirable along the Port Warden Lines bounding Berkley Flats in order to reclaim them by the use of the dredged material, and at the same time maintain the dredged channel.

The following sketch* shows plan of bulkhead proposed.

Total length, feet	3,000
Average depth at mean low water, feet	10

The cost of the foregoing bulkhead and the total dredging is estimated as follows:

3,000 piles, 12 inches square and 30 feet long=1,080,000 feet, B. M., at $25 per M	$27,000 00

* Omitted.

Creosoting 3,000 piles, 30 feet long = 90,000 cubic feet, at 25 cents	$22,500 00
Driving 3,000 piles, at $1	3,000 00
6,000 linear feet of binding logs, at 18 cents	1,080 00
Waling timbers, 72,000 feet B. M., at $25 per M.	1,440 00
Creosoting waling timbers, 6,000 cubic feet, at 25 cents	1,500 00
18,000 pounds iron, at 4½ cents	810 00
600 round piles, 10 inches diameter at middle, 24 feet long = 14,400 linear feet, at 15 cents	2,160 00
600 tie-pieces, 3x12 inches by 18 feet = 32,400, B. M., at $15 per M.	486 00
Total	59,976 00
10 per cent. for contingencies	5,997 60
Bulkhead at Berkley Flats	65,973 60
482,480 cubic yards material, at 13 cents	62,722 40
1,722,948 cubic yards material, at 22 cents	379,048 56
Total with bulkhead at Berkley Flats	507,744 56
Total without bulkhead at Berkley Flats = 2,205,428 cubic yards material, at 22 cents	485,194 16
Difference	22,550 40

It is not thought at all likely that the building of this bulkhead would be permitted without legal difficulties, as it is understood there are many conflicting interests involved.

It is believed that, could the foregoing be executed, the channels would maintain themselves very largely and do away with dredging to a great extent—in fact, "present evils" would be generally cured. No good comparison of this plan can be made with "the method of dredging annually." It is manifest, however, that a comparison would be in favor of the former, it being of a more permanent nature—in fact, as permanent as circumstances will admit of.

The following table shows the present acreage of the harbor:

Over 25 feet in depth	203
Over 18 feet in depth	337.5
Over 12 feet in depth	409.7
Over 6 feet in depth	483.8
Under 6 feet in depth	444.7
Total number of acres (483.8+444.7)	928.5

The point "*r*" should not be advanced, for the reason given by the Advisory Board. The harbor is now none too large for the extensive and rapidly-increasing trade seeking it, and therefore should not be curtailed any more than is absolutely necessary.

Very respectfully, your obedient servant,

F. A. HINMAN,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.
(Through Lieut. Col. W. P. Craighill, Corps of Engineers.)

L 2.

IMPROVEMENT OF APPROACH TO NORFOLK HARBOR AND THE UNITED STATES (NORFOLK) NAVY-YARD BETWEEN LAMBERT'S POINT AND FORT NORFOLK, VIRGINIA.

There were no operations during the fiscal year ending June 30, 1885, except to survey the locality in question in September and October last, and to make a map of the same on a scale of 0.0001. The adopted port warden lines aggregate 50,935 feet in length.

The act of July 5, 1884, appropriated $50,000 specifically to widen the

channel of this portion of Elizabeth River. A Board of Engineer Officers was convened last August to prepare a project for the application of this appropriation, and submitted reports thereon. (Copies herewith.) The Board reported a plan involving, in conjunction with dredging, the construction of a dike at or near Pinner Point, expressing at the same time doubts whether, under the phraseology of the law, any part of the money could be applied to a work of construction.

However, the requirements of navigation demanding the widening of the channel as contemplated in the project already commenced and partly executed by dredging, it was recommended that the existing appropriation be applied to widening the channel between Lambert's Point and Fort Norfolk by dredging along the eastern side thereof. This having been approved, the work has been advertised accordingly. It is expected to increase the width of the 25-foot channel at ordinary low water at least 300 feet, and to remove the 24-foot shoal in the upper part of it.

An allotment of $3,000 has been made from the fund available for this work for the building of a steam-tender. For the details relative thereto see report for this fiscal year on harbor at Norfolk, Virginia, and its approaches.

It is proposed to apply future appropriations to improving this approach by the construction of a dike and by dredging, as shown in my report to the Chief of Engineers dated June 30, 1885. (Copy herewith, accompanied by map.)

For commercial statistics see report for this fiscal year on harbor at Norfolk, Virginia, and its approaches, of which this is a part.

Norfolk is a port of entry.

Money statement.

Amount appropriated by act approved July 5, 1884		$50,000 00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$379 40	
July 1, 1885, outstanding liabilities	1 96	
		381 36
July 1, 1885, amount available		49,618 64
Amount that can be profitably expended in fiscal year ending June 30, 1887 Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		255,600 00

LETTER OF THE CHIEF OF ENGINEERS.

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., August 18, 1884.

SIR: The river and harbor act of July 5, 1884, provides as follows:

Improving approach to Norfolk Harbor and the United States (Norfolk) Navy-Yard; continuing improvement, the widening of the channel of the Elizabeth River between Lambert's Point and Fort Norfolk, fifty thousand dollars.

For the purpose of recommending a project for the application of this appropriation I have to suggest that a Board of Engineers be constituted, consisting of the following named officers of the Corps of Engineers: Maj. Peter C. Hains, Capt. James Mercur, and Capt. Frederick A. Hinman, to meet in Norfolk, upon the call of the senior member, as soon

as the other duties of the members will permit, and with your sanction the order convening the Board will be issued from this office.

The Board, among other projects, will consider the feasibility of widening, deepening, and maintaining the channel between the points above named by the construction of a dike or training-wall, beginning at or near Pinner Point, and extending a suitable length in a northwesterly direction, causing, among other advantages, the channel of the Western Branch to enter the Elizabeth River at a proper angle.

The expenses of the Board should be paid by Captain Hinman from the appropriation contained in the above-quoted item.

The journeys to be made by the members of the Board to fulfill these duties are necessary for the public service.

Very respectfully, your obedient servant,

JOHN NEWTON,
Chief of Engineers, Brig. and Bvt. Maj. Gen.

Hon. ROBERT T. LINCOLN,
Secretary of War.

[First indorsement.]

Approved.

JOHN TWEEDALE,
Chief Clerk.
(For the Secretary of War in his absence.)

WAR DEPARTMENT, *August* 21, 1884.

LETTER OF THE CHIEF OF ENGINEERS.

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., August 28, 1884.

SIR: For the information of the Board of Engineers constituted by General Orders No. 110, Headquarters Corps of Engineers, current series, for the purpose of recommending a project for the application of the appropriation of July 5, 1884, for improving approach to Norfolk Harbor and the United States (Norfolk) navy-yard, &c., there are transmitted herewith the following papers:

Letter of June 20, 1884, from Hon. William Mahone, United States Senate, to the Chief of Engineers, requesting his views upon proposition contained in the amendment (herewith inclosed) to the river and harbor bill then pending before Congress.

Copy of letter of the Chief of Engineers of June 23, 1884, submitting to the Secretary of War, with remarks, the above letter from Senator Mahone.

Press copy of letter of the Secretary of War of June 25, 1884, transmitting to Senator Mahone the letter of the Chief of Engineers of June 23.

Letter of the Chief of Engineers, dated August 18, 1884, to the Secretary of War, suggesting appointment of the present Board, to consider the subject and present project for the application of the existing appropriation.

Captain Hinman will place before the Board all maps, plans, and other information in his possession relating in any manner to the improvement under consideration, and it is desired that the Board carefully examine into the subject and submit to this office a report, with

plan and estimates, for the purpose of carrying into effect the improvement contemplated by the act of July 5, 1884.

The expenses of the Board will be paid by Capt. F. A. Hinman, Corps of Engineers, from the appropriation for "improving harbor at Norfolk, Va."

By command of Brigadier-General Newton.

Very respectfully, your obedient servant,

JOHN G. PARKE,
Colonel of Engineers, Bvt. Maj. Gen., U. S. A.

Maj. P. C. HAINS,
Corps of Engineers.

LETTER OF HON. WILLIAM MAHONE.

UNITED STATES SENATE,
Washington, D. C., June 20, 1884.

GENERAL: My friend Col. William Lamb, mayor of Norfolk, has already called your attention to the limited channel-way leading to the harbor of Norfolk.

May I ask your views of the proposition contained in the inclosed amendment and at the earliest day it may be possible for you to give them.

Yours, truly,

MAHONE.

General NEWTON,
Chief of Engineers.

LETTER OF THE SECRETARY OF WAR.

WAR DEPARTMENT,
Washington City, June 25, 1884.

SIR: Acknowledging the receipt of your letter of the 20th instant, inclosing, with request for the views of this Department thereon, a copy of a proposed amendment to H. R. 7012, a bill making appropriations for the construction, repair, and preservation of certain public works on rivers and harbors, and for other purposes, I have the honor to state that the subject was referred to the Chief of Engineers, and to inclose herewith his report, dated the 23d instant, in which I concur.

The copy of the proposed amendment received with your letter is herewith returned.

Very respectfully, your obedient servant,

ROBERT T. LINCOLN,
Secretary of War.

Hon. WILLIAM MAHONE,
United States Senate.

PROCEEDINGS OF A BOARD OF ENGINEER OFFICERS CONVENED AT NORFOLK, VIRGINIA.

UNITED STATES ENGINEER OFFICE, NORFOLK, VA.,
Tuesday, September 2, 1884—10 a. m.

The Board met, pursuant to Special Orders No. 110, headquarters Corps of Engineers, August 27, 1884, upon the call of the senior member. Present, all the members.

* * * * * * *

UNITED STATES ENGINEER OFFICE, NORFOLK, VA.,
Wednesday, September 3, 1884—10 a. m.

The Board met, pursuant to adjournment. Present, all the members. Captain Hinman submitted a skeleton map* of the locality, showing

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* Omitted.

thereon the 6, 12, and 18 foot contours of all the surveys extant, *i. e.*, those of 1854, 1871, and 1882, on which were also the 25-foot contours of the survey of 1882 and the location of the only dredging in the locality done between 1878 and 1880, inclusive, and resulting in a cut 4,400 feet in length by 265 feet in width and 25 feet in depth at mean low water.

An examination of this map shows that the channel both above and below the mouth of Western Branch is of good width, depth, and direction, the 25-foot channel being about 600 feet wide above and of greater and increasing width below. At the mouth it is quite irregular in width, and has a middle ground, the 25-foot channel being from 100 to 300 feet in width. This is believed to be due to the conflict of the tides of the main river and its affluent, the Western Branch.

Since the last survey, made in 1882, a comparatively close railroad pier, 2,430 feet in length, has been projected at Lambert's Point from the shore out to the light-house and is now nearly completed. This, doubtless, has produced changes in the tides, and changes in the channel may be expected to follow, if they have not already been made.

Captain Hinman has commenced a survey of the locality under consideration, and contemplates making current observations for velocity, direction, &c., in connection therewith, which will take about three weeks to complete it.

It is noticed that some deterioration has already occurred in the dredged channel, and, as over two years have elapsed since the last survey was made, the survey in progress will show its present condition and afford the Board better data on which to base a project relative to a dike and dredging.

The Board, being of the opinion that this is required for a proper study of the questions involved, resolved to adjourn to-day to meet again, on the call of the senior member, as soon as Captain Hinman reports the survey finished.

Respectfully submitted.

PETER C. HAINS,
Major of Engineers.
JAS. MERCUR,
Captain of Engineers.
F. A. HINMAN,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

REPORT OF BOARD OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Norfolk, Va., October 29, 1884.

GENERAL: The Board of Engineers, constituted by Special Orders 110, headquarters Corps of Engineers, August 27, 1884, reassembled at this city October 28, 1884, but a change in its membership had taken place since its first meeting and the rendition of the preliminary report of September 3, 1884. This change made, by the authority of the Secretary of War, consisted in the substitution of Lieut. Col. W. P. Craighill for Capt. James Mercur, who had been appointed Professor of Engineering at the United States Military Academy at West Point.

The Chief of Engineers, in his letter of October 1, having notified the Board that the mayor of Norfolk and others wished to submit their views on the subject under consideration, the mayor had been, by letter,

requested to meet the Board October 28 at 12 m. This he did, accompanied by the Hon. Mr. Libby, member of the House of Representatives from the Norfolk district, and by Mr. Keen, assistant engineer of the Norfolk and Western Railroad. Later in the day Mr. Coe, chief engineer of the same railroad, presented his views to the Board.

The remainder of October 28 was passed by the Board in examining the map of the survey, recently made by Mr. George H. Elliott, assistant engineer under Captain Hinman's direction, of the water area between Lambert's Point and Fort Norfolk, and its comparison with previous maps and in the discussion of the whole subject.

The law relative to this matter is in the following words:

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following sums of money be and are hereby appropriated, to be paid out of any money in the Treasury not otherwise appropriated, and to be expended under the direction of the Secretary of War for the construction, completion, repair, and preservation of the public works hereinafter named:

* * * * * * *

Improving approach to Norfolk Harbor and the United States (Norfolk) navy-yard; continuing improvement, the widening of the channel of the Elizabeth River, between Lambert's Point and Fort Norfolk, fifty thousand dollars. * * *

Approved July 5, 1884.

The most obvious thing to do, under a natural construction of the language of the law, would be to widen the channel in its narrowest parts between Lambert's Point and Fort Norfolk, by removing the shoals which have less than 25 feet of water upon them, in order to facilitate the approach to Norfolk of commercial vessels of large draught, as well as the approach to the navy-yard of vessels of war.

At this point of its investigations the Board is met by the expression of the belief, on the part of the mayor of Norfolk and others, that it was the intention of Congress to have this special appropriation of $50,000 expended in dredging near the head of the long pier lately built by the Norfolk and Western Railroad Company from the mainland at Lambert's Point to the light-house at the end of the shoal, where two important branches of the Port Warden's Lines intersect, which lines have been established under the laws of the State of Virginia. This area proposed to be dredged is shown on the accompanying map, prepared by Mr. Coe and presented by Mayor Lamb.

In this connection the following letters are inserted herein, immediately below:

MAYOR'S OFFICE,
Norfolk, Va., October 28, 1884.

DEAR SIR: In relation to the special use of the appropriation of $50,000, given at the last session of Congress for widening the channel of the Elizabeth River between Lambert's Point and Fort Norfolk, I would respectfully state that I was called upon by the unanimous vote of the Board of Trade and the Cotton Exchange, as mayor of the city, to go to Washington to use all my influence to obtain an appropriation of $100,000 from Congress to meet the developments of commerce in our lower harbor by the Norfolk and Western Railroad Company. I accepted upon the condition that I was representing all interests in our community, and with the distinct understanding that I should not accept any remuneration, but would be allowed to pay my own expenses. Since the sale of the Atlantic, Mississippi and Ohio Railroad, and its reorganization as the Norfolk and Western Railroad, as mayor of this city I have been requested to preside at its stockholders' meetings, and although I hold no position in the road and my pecuniary interest is very small, ten shares of common stock, yet I am deeply interested in its schemes for enlarging and extending the trade of Norfolk.

I think I express the feeling of our entire people when I represent that the future of our city depends almost exclusively upon the Norfolk and Western Railroad.

What the Baltimore and Ohio Railroad has been to Baltimore, the Pennsylvania Railroad to Philadelphia, and the Erie Railroad to New York, we expect in time the Norfolk and Western Railroad will be to us. A very large portion of our city's debt was contracted to build this road, and now that the corporation has lost its stock by

the sale of the original road under foreclosure, the only return possible is in an increased trade, affording increased opportunities for our people to acquire wealth. It is this identity of interest between the railroad and the town which has made our people a unit in urging the assistance of the General Government in enlarging the lower harbor to meet the great enterprises of this corporation. We feel that the policy of the Government in fostering and building up commerce should be to assist those who assist themselves, and, as our municipality is too poor to expend money in enlarging its wharf facilities, we are glad to be represented by a corporation that can add to our welfare while increasing its own.

In conclusion, as the mayor of the city of Norfolk, and in continuance of the duty, I cheerfully undertook to obtain an appropriation from Congress. I most earnestly ask of your honorable body to do all that your sense of what is right and proper will admit, towards furthering the desires of our people, not to do anything for the railroad that it should do for itself, but to encourage its improvement of navigation and the development of commerce, by meeting the same, by deepening the channel along its water-front, a work which could not be used exclusively for its benefit, but must be free to the whole commerce of the port including the vessels of war entering and departing our harbor.

Very respectfully,

WILLIAM LAMB,
Mayor.

Col. WM. P. CRAIGHILL,
President Board of Engineers.

P. S.—I should mention that while the Norfolk and Western Railroad, with its coal piers, cotton-presses, and grain-elevator, will have the largest interest at Lambert's Point, that it does not own the whole of the water privileges, but that other parties are interested, and it is expected that the terminal facilities at this point will be used by the Seaboard and Roanoke Railroad and the Norfolk Southern Railroad for their foreign trade. The inner basin from Fort Norfolk to the iron bridge and navy-yard, will soon be all needed for the coastwise steam and sail vessels, while the lower harbor must be utilized for foreign commerce as Locust Point is by Baltimore.

PETERSBURG, VA., *October* 5, 1884.

COLONEL: In response to your inquiry I beg to say that there were two distinct appropriations made by the last Congress, at the last session.

(1) One of $25,000 for continuing improvement of harbor.

(2) One of $50,000 for widening channel between Lambert's Point and Fort Norfolk, so as to promote at the same time the proper development of the frontage of wharfage accommodation of the harbor on the eastern boundary of Port Warden Line, as set out in the memorial to Congress; and this appropriation was made on the exhibition of a Coast Survey map, illustrating the great need of a wider channel-way, and I know was distinctively intended for the particular and express purpose, and therefore not added to the $25,000.

Yours, truly,

MAHONE.

Col. WM. LAMB,
Norfolk City, Va.

The Board recognizes fully the importance of the statements contained in these letters, and desires to give them full weight.

Among the papers placed before the Board was the following letter from the Chief of Engineers:

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., June 23, 1884.

SIR: I have the honor to submit the accompanying communication from Senator Mahone, dated the 20th instant and received to-day, with inclosed amendment intended to be proposed by him to the river and harbor act (H. R. 7012) now pending in the Senate, and to remark in regard to it as follows:

I think it important to improve that part of the channel between Fort Norfolk and Lambert's Point, and am of the opinion that the first step to be taken should be the construction of a dike to deflect the waters of the Western Branch so as to compel them to enter the channel of the Elizabeth River at a proper acute angle, before much money should be laid out in dredging, as it is most probable that the shoaling of that part of the channel of the Elizabeth River, both in depth and width, is caused to some,

perhaps a great, extent by the faulty direction of the Western Branch at its junction with the Elizabeth.

This dike, creosoted, to protect it from the worm, would probaby cost $100,000.

Before adopting a definite project for this work, important for naval even more than for commercial purposes, an examination should be made in order that more information than is furnished by the existing charts may be obtained.

Very respectfully, your obedient servant,

JOHN NEWTON,
Chief of Engineers,
Brig. and Bvt. Maj. Gen.

Hon. ROBERT T. LINCOLN,
Secretary of War.

The views of the Chief of Engineers were concurred in by the Secretary of War, as appears from his letter of June 25 to Hon. William Mahone.

The Board invites attention to the fact that the long pier lately built by the Norfolk and Western Railroad Company, terminating at the Lambert's Point Light, is really a jetty or dike, and repeats the statement of the preliminary report of September 3 relative thereto, viz:

> This doubtless has produced changes in the tides, and changes in the channel may be expected to follow.

The Board is of the opinion that the channel between Lambert's Point and Fort Norfolk would be much improved by the construction of a dike beginning at or near Pinner Point, and carried in a direction parallel to the branch of the Port Warden's Line on the east side of the river, its length to be about 1 mile and its height about the level of high water. The full benefit of this dike cannot be realized, it is thought, until the said branch of the Port Warden's Line, now existing only on paper, becomes a real line in the place assigned it. It is important also to note that the effect of the only dredging done in this locality, between 1878 and 1880, no dike being in existence, has failed to be permanent, and it may be confidently expected that a dredged channel cannot be maintained there without occasional dredging until after the construction of the Pinner Point Dike. While the Board advocates this dike, it has doubts, under the specific phraseology of the law, whether the whole or any part of the appropriation under consideration can be applied to its construction at this time. However, were this now applicable to the dike it would seem best to refrain from building it until time has shown the full effects of the Lambert's Point Dike. In view of the uncertainties of the situation, the considerable time—six weeks or two months—before work could properly be now commenced with the present appropriation, the fact that Congress will soon again be in session and that the session will be a short one, it seems to the Board most judicious to refrain from expending the present appropriation until Congress can be further consulted, unless the money be applied to dredging in the narrowest and shoalest parts of the channel. But the permanence of such dredging cannot be considered as assured until the dike from Pinner Point be built.

The Board deems a width of 400 feet sufficient for all purposes of a channel between Lambert's Point and Fort Norfolk, to dredge which to a depth of 25 feet at mean low water will require the removal of 87,515 cubic yards of material, at a cost of $19,253.30, on the basis of 20 cents per cubic yard, measured in place. Wider channels will cost as follows:

500 feet	$43,429 54
600 feet	65,918 38
700 feet	95,414 66
800 feet	134,036 76
900 feet	171,355 36
1,000 feet	228,147 92

The ravages of the worm in these waters make it expedient, even necessary, in the construction of the Pinner Point Dike to dispense with the use of timber to a great extent, or to have it protected by creosote or other means of increasing its durability. Concrete has decided advantages for the construction of such a dike under existing circumstances. The local engineer, Captain Hinman, presents a plan for its use, the character of which will be seen from one of the accompanying drawings. It is not thought necessary that the Board should prescribe the details of such a structure, as they may be greatly varied and perhaps improved by further study and experience.

The method of the local engineer is used as a basis for the estimate. The cost of such a dike as has been proposed by the Board, the location of which is approximately shown on one of the accompanying maps, will be $97,136.14. The height assigned to the dike is fixed by the consideration that its object is to control the whole of the tidal flow, and experience has moreover shown that in such a locality a structure of this kind should be easily seen by navigators; otherwise there is great danger from it as an obstruction to navigation.

The estimate of the Board for the improvement of this portion of the approach to Norfolk, which amounts to $116,389.44, including an item of 10 per cent. for contingencies, is limited to the dredging of a channel 400 feet wide and the construction of the Pinner Point Dike.

In conclusion, the Board invites attention to the great importance of liberal expenditures for the improvement of the harbor of Norfolk and its approaches, in which the United States Government is directly interested, in connection with the existence here of one of its most important navy-yards, as well as in the great commercial development of which the natural advantages of Norfolk make her capable, and that now seems about to be realized.

The maps and drawings sent to illustrate this report are the following:

Three maps of approach to Norfolk Harbor, Va., between Craney Island and Fort Norfolk, including Western Branch, from survey of 1884, made under the direction of Capt. F. A. Hinman, Corps of Engineers, by Mr. George H. Elliott, assistant engineer, showing soundings, contours, current lines, proposed dike, &c. Comparative chart of Elizabeth River, from Craney Island light-house to Norfolk navy-yard, Va., compiled from United States Coast Survey charts, showing contours of surveys of 1854, 1872–'73, and 1882.

Map, in duplicate, of vicinity of Lambert's Point light-house, by W. W. Coe, chief engineer, Norfolk and Western Railroad.

Plan of concrete dike with timber foundation for Norfolk Harbor, devised by Capt. F. A. Hinman, Corps of Engineers.

The papers which accompany the instructions of the Chief of Engineers to the Board, dated August 28, 1884, are deemed important to a full understanding of the subject of this report, and they are all returned herewith, with the recommendation that they be regarded as appendices to it and go with it should the report be printed or be otherwise made public.

Respectfully submitted.

WM. P. CRAIGHILL,
Lieutenant Colonel of Engineers.
PETER C. HAINS,
Major of Engineers.
F. A. HINMAN,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

PROJECT OF CAPTAIN F. A. HINMAN, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Norfolk, Va., June 30, 1885.

GENERAL: I have the honor to submit the following project for the improvement of the approach to Norfolk Harbor and the United States navy-yard:

I respectfully transmit herewith tracing of map of my latest survey of this locality, on which will be found the Port Warden Lines on the easterly side as recommended by the United States Advisory Board and adopted by the Harbor Commissioners of Norfolk and Portsmouth, Va. The reasons for the location of said lines are given in the accompanying copies of communications dated August and November, 1883, respectively, from said Advisory Board to said Board of Harbor Commissioners. It will be noticed that these lines are remote from the channel, and that therefore a veto is virtually put upon the use of the water-front for purposes of navigation and commerce. This front is now being used extensively at Lambert's Point, the Norfolk and Western Railroad having been lately extended there, and in the near future it is believed that parties will desire to utilize a large portion of the balance of the front between Fort Norfolk and Lambert's Point.

In view of the foregoing it is proposed to advance the Port Warden Line from Fort Norfolk to Lambert's Point out to about the 12-foot curve, as shown on the accompanying map, and to widen the channel by dredging the area shown in blue on said map to a depth of 25 feet at mean low water.

The dike proposed for this locality is shown on said tracing as approximately located by the Board of Engineers last year. It is recommended that the longer area, 4,000 feet, be located as shown thereon by broken blue line, 1,700 feet from and parallel to the proposed Port Warden Line. It is thought that this plan when executed will "deflect the waters of the Western Branch so as to compel them to enter the channel of the Elizabeth River at a proper acute angle," and that the channel will be more apt to maintain itself in consequence thereof. The work should be done in the following order: (1) Build the dike; (2) dredge the channel, and (3) allow structures to be built out to the proposed Port Warden Line.

I estimate the cost of the foregoing as follows:

Dike (in round numbers)	$106,000
Dredging (in round numbers) 680,000 cubic yards, measured in place, at 22 cents	149,600
Total	255,600

Very respectfully, your obedient servant,

F. A. HINMAN,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.
(Through Lieut. Col. William P. Craighill, Corps of Engineers.)

LETTER OF THE UNITED STATES ADVISORY BOARD TO THE BOARD OF HARBOR COMMISSIONERS.

NORFOLK, VA., *August*, 1883.

GENERAL: Your letter of the 19th July last, asking, in the name of the Board of Harbor Commissioners of Norfolk and Portsmouth, for the

MAP OF
APPROACH TO NORFOLK HARBOR, VA.,
FROM LAMBERT'S POINT TO FORT NORFOLK.

From survey made under the direction of
Capt. F. A. HINMAN,
Corps of Engineers, U.S.A.,
Sept. and Oct., 1884.

Scale. 100 0. 500 1000 1500. 2000. 2500. Feet.

NOTE.— *The curves are referred to mean low-water, the plane of reference.*
Mean rise and fall of tides.— 2.7 feet.
The 6 feet curve is shown thus:
" 12 " " " " "
" 18 " " " " "
" 25 " " " " "

ELIZABETH R.

Railroad Pier, sheathed on North side.

LAMBERT PT LT

3.

5.

Ultimate Dredgeing To be dredged in 1885

Proposed Port Warden Line.

Approx. Rmtd location of Bike proposed by Board of Engineer Officers.

Proposed Dike.

True North.

WESTERN BRANCH.

To accompany my Annual Report of 1885.
F. A. Hinman
Captain of Engineers.

Fort Norfolk.

Pinner Pt.

H Ex1 pt2 v2 49 1

recommendation of the United States Advisory Board upon the establishment of Port Warden's Lines, where not already located in the harbor of Norfolk and Portsmouth, so far as the authority of the Harbor Commissioners extends, and also for lines in the branches and creeks emptying into Elizabeth River, was received during the absence of one member, Capt. C. O. Boutelle, United States Coast Survey, of the Advisory Board from this city, he being engaged in the field work of the Coast and Geodetic Survey.

This absence has up to this time prevented a full discussion of the subject submitted, but fortunately at a meeting of the Advisory Board, held before Captain Boutelle left the city, his views upon the proper location of the Port Warden's Line from Fort Norfolk to Tanner's Creek were obtained, and, agreeing with those of the other members of the Board, a recommendation can be at once submitted to your Board upon this part of the line.

So soon as practicable the other parts will be considered, and a report giving the conclusions reached will be forwarded for such action as your Board may consider advisable.

The general considerations which should regulate the establishment of Port Warden's Lines having been fully stated in the report of the Advisory Board to the Board of Harbor Commissioners, dated January 27, 1877, it is unnecessary to repeat them here or to enter into any argument upon the reasons which led to the selection of the lines recommended, except to state that it is established as near the deep water as a proper regard for the width of channel needed for the accommodation of the very large and constantly increasing fleet of small sail-boats carrying produce to the city and the area of tidal basin required for the preservation of the deep channel through Sewell's Point Bar will allow.

This last consideration being one of great importance in deciding the amount of allowable contraction in the area of the entire inner harbor, and the former having much greater weight than at first appears, from the fact that the navigation laws give to sailing craft right of way over steamers, and consequently room must be allowed for the sailing craft, however small and light draught, so that the deep straight channel available for large steamers may not be blocked by them.

From these considerations the Advisory Board respectfully recommend the following as the continuation of the Port Warden's Line from point A on the Fort Norfolk Wharf to Tanner's Creek, viz:

From point A, as established by the Board of Harbor Commissioners, on Fort Norfolk Wharf, north 44° 30′ west in a straight line 8,760 feet to point 5; thence north 14° 38′ west in a straight line 2,330 feet to point 3; thence north 24° 55′ east in a straight line 9,190 feet to point 1.

These points are all in the water, and must be located by careful instrumental determinations. In this connection your attention is respectfully invited to the recommendation made in the letter of the Advisory Board to the Board of Harbor Commissioners of March 8, 1883.

This line as recommended crosses the mouths of Tyrants and Lambert's creeks and a creek not named, so far as is known, just below Lambert's Point. It is respectfully recommended that suitable outlets be left for these creeks for the ingress and egress of tides and the passing in and out of the small boats owned by farmers and others upon the creeks. Proper drainage and rapid exchange of water require a larger opening than would be necessary for boats alone. It is the opinion of the Advisory Board that an opening of 200 feet in width for Tyrants Creek and 400 feet for Lambert's Creek should be allowed, and channels of this width and perpendicular to the Port Warden's Line should

be located at the mouths of these creeks, and should be kept open. No topographical information is in possession of this Board from which to determine the width of opening advisable at the mouth of the unnamed creek immediately below Lambert's Point, or whether or not other openings should be left between this point and Tanner's Creek.

In conclusion, it should be said that no recommendations could have been made by this Board, owing to lack of maps of the harbor, had not the Superintendent of the Coast Survey most courteously placed at our disposal the results of the latest surveys, made in 1882, tracings and advanced sheets of which were furnished to us.

This survey extends to Tanner's Creek on the right and Craney Island on the left bank, both of which are well marked terminal points for the Port Warden's Lines.

Very respectfully,

W. T. TRUXTUN,
Commodore, United States Navy,
JAMES MERCUR,
Captain of Engineers.
CHARLES O. BOUTELLE,
Assistant, United States Coast and Geodetic Survey.

General V. D. GRONER,
President of the Board of Harbor Commissioners of Norfolk and Portsmouth, Va.

ADDENDUM.

NORFOLK, VA., *November* 24, 1883.

In accordance with a request to that effect from the Norfolk Terminal Company, referred to your Advisory Board by the Board of Harbor Commissioners, the Advisory Board have this day inspected that point of the channel of the Elizabeth River near Lambert's Point light.

After examining the ground and hearing some of the parties interested, the Advisory Board conclude that no material injury to the harbor or channel is likely to result if the Port Warden's Lines be so modified that the prolongation of the lines from 1 to 3 and from Fort Norfolk to (5), which will intersect at the Lambert's Point light-house, be taken as the Port Warden's Lines for this part of the channel.

Your Advisory Board would most earnestly recommend, however, that no permit for the construction of wharves extending out to the light-house be granted until a pledge and guarantee satisfactory to the Light-House Board be given that the said light-house shall be rebuilt, at the expense of the party building the wharf, to such height that it shall be plainly visible over the wharves, and in accordance in all respects with the requirements of the Light-House Board, and with their consent.

W. T. TRUXTUN,
Commodore, United States Navy,
JAMES MERCUR,
Captain of Engineers.
CHARLES O. BOUTELLE,
Assistant, United States Coast and Geodetic Survey.

L 3.

IMPROVEMENT OF APPOMATTOX RIVER, VIRGINIA.

This work was in charge of Lieut. Col. William P. Craighill, Corps of Engineers, with Lieut. C. McD. Townsend as his assistant resident engineer until July 26, 1884, when they were relieved of it.

The act of July 5, 1884, appropriated $25,000 for this work. A project for the expenditure thereof was submitted on August 25, 1884, to the Chief of Engineers and duly approved. In accordance therewith proposals were invited for dredging, and on October 30, 1884, a contract was entered into with A. F. Hall, esq., the lowest bidder, to do the work at 13¼ cents per cubic yard, measured in place, the material to be deposited on the bank.

Work was to have been commenced, under the contract, December 1, 1884, but for various reasons Mr. Hall did not begin operations until January 24, 1885. Up to June 30, 1885, he removed 51,300 cubic yards. Being unable to complete the contract by the time specified therein, June 1, 1885, he asked for and obtained an extension of the time to August 20, 1885. The total amount to be removed under the contract is 135,000 cubic yards, more or less, measured in place.

This dredging has all been applied to widening Puddledock Cut, along the westerly side, one cut having been made nearly the entire length thereof, 9,700 feet, about 30 feet wide and 5 feet deep.

The material dredged varied somewhat. At the upper end it was sand and gravel; in the middle soft mud, roots, and stumps, easily removed by the clam-shell dredge; and at the lower end hard, coarse gravel. Trouble was experienced in the middle where the cut crosses several branches of the river proper, and piling, &c., aggregating 800 linear feet, will be resorted to to hold up the bank. It is proposed ultimately to make Puddledock Cut 140 feet wide and 12 feet deep at mean high water.

The following work was done by the hire of labor and machinery and the use of the United States plant. Jetties 19 and 20 were repaired at the outer ends where injured by freshets, and, together with jetty 18, were extended and T's built on them, which required the construction of 374 feet of dike.

The closure-dike was extended 380 feet down to the head of Puddledock Cut, and Poor Run Dike was extended 810 feet, making a total of 1,564 linear feet, the proper contraction of the river at those points to 140 feet in order to check the formation of shoals.

Three lines of longitudinal soundings were made simultaneously, June 16, between Petersburg and Point of Rocks, one from the bow of the tug and the other two from skiffs fastened amidships, 28 feet apart. They were taken as fast as the sounding-rods could be used, the tug moving slowly. These soundings show a fair channel, generally, at least 12 feet deep at mean high water, except at points where short shoals have formed, with depths thereon as follows:

	Feet
Jetty 9	10.7
Jetty 13	10.8
Jetty A	10.2
Jetty E	10.6
Jetty G	9.5
Jetty L	10.1
Jetty 12	10.6
Jetty 19	11.5
Jetty 21	9.9

It is thought that these shoals will not be so apt to form after removal, especially when Puddledock Cut is finished, thereby admitting more tidal water to maintain the channel. The enterprising city of Petersburg, with its accustomed liberality towards the improvement, has lately put her dredge to work removing them and intends to do other needed work in the harbor, as stated in the accompanying communication from E. H. Stainback, esq., port-warden, dated July 14, 1881. It is understood that the city will also take measures to stop the bad practice of throwing the refuse of mills into the river.

The sum of $46,000 can be profitably expended in the fiscal year ending June 30, 1887, with which it is proposed to complete the improvement as projected, to the great benefit of navigation and commerce. It is estimated that $5,000 will be required yearly thereafter to maintain the work, parts of which are of a temporary character and will need repairs.

The following statistics, relative to tobacco, have been compiled:

Year.	Tax collected from tobacco manufactured in—			Tobacco manufactured in the United States exported.	Tobacco manufactured in Petersburg exported.
	United States.	Virginia.	Petersburg.		
				Pounds.	*Pounds.*
1877	$27,053,072 38	$7,932,220 78	$1,073,508 06	11,385,046	5,013,581
1878	25,326,153 08	6,501,730 29	1,151,147 04	10,581,744	4,906,591
1879	24,703,874 90	6,448,546 88	895,474 26	11,034,951	3,386,904
1880	21,170,154 40	5,781,409 58	746,732 90	9,808,409	3,886,804
1881	22,833,287 60	6,063,105 75	966,057 38	10,686,132	3,508,773
1882	25,033,741 97	6,226,308 30	706,595 29	10,829,215	4,718,157
1883	23,834,951 86	4,764,228 40	577,033 71	11,180,645	3,916,192
1884	13,936,258 99	2,706,615 37	488,146 32	10,637,603	3,772,063

The commercial statistics are appended hereto.

Petersburg is a port of entry.

Money statement.

July 1, 1884, amount available		$6,960 82
Amount appropriated by act approved July 5, 1884		25,000 00
Amount received from an officer for fuel		49 50
		32,010 32
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$19,850 73	
July 1, 1885, outstanding liabilities	1,722 50	
		21,573 23
July 1, 1885, amount available		10,437 09
Amount (estimated) required for completion of existing project		46,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		46,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals received for dredging and for furnishing piles, lumber, gravel, brush, binding-poles, bolts, and spikes for improvement of Appomattox River, Virginia, opened by Capt. F. A. Hinman, Corps of Engineers, at Norfolk, Va., October 23, 1884.

No.	Names and addresses of bidders.	Number and kind of machines to be used.	Average capacity daily.	Date commencement and completion of work.	Prices.				
					Dredging, per cubic yard.	Piles, each.	Gravel, per cubic yard.	Brush, per cord.	Binding poles, each.
			Cu. yds.		*Cents.*		*Cents.*		*Cents.*
1	Wm. F. Gatling, Petersburg, Va.	.....	.....	.....	.....	.....	46	$1 44	4½
2	A. F. Hall, New York, N. Y.	One or two dredges.	.....	According to specification.	13¼	.....	.....	.....	.....
3	P. Sanford Ross, Jersey City, N. J.	One large dipper dredge.	.....	....do	14⅜	.....	.....	.....	.....
4	Morris & Cumings Dredging Company, New York, N. Y.	One or two dredges.	.....	....do	25	.....	.....	.....	.....
5	Thomas P. Morgan, Washington, D. C.	Two dredges.	1,000	....do	13 2/16	.....	.....	.....	.....
6	Simon West, Petersburg, Va.	.....	.....	.....	.....	$1 05	23	*1 45	20
7	James Caler & Son, Norfolk, Va.	All necessary appliances.	400	Commence March 1, 1884, and complete on or before August 1, 1885.	29	.....	.....	.....	.....

* 100 cords.

Contracts with A. F. Hall for dredging, and with William F. Gatling for brush and binding poles.

Abstract of proposals received for furnishing piles, lumber, gravel, bolts, and spikes in response to circular dated November 5, 1884, for improvement of Appomattox River, Virginia, opened by Capt. F. A. Hinman, Corps of Engineers, at Norfolk, Va., November 15, 1884.

No.	Names and addresses of bidders.	Date of delivery.	Prices.					
			Piles, each.	Lumber, per M.	Gravel, per cubic yard.	Bolts, per pound.	Spikes.	
							Wrought, per pound.	Cut, per pound.
			Cents.		*Cents.*	*Cents.*	*Cents.*	*Cents.*
1	B. A. Davis, superintendent, Bermuda Ochre Company, Petersburg, Va.	.....	*94	.....	.....	.....	.....	.....
2	Joseph A. Tucker, jr., New York, N. Y.	.....	.....	.....	.....	*6¼	4¼	3¼
3	E. V. White & Co., Norfolk, Va.	.....	.....	.....	.....	6	3½	3
4	H. T. Morrison & Co., Petersburg, Va.	.....	.....	.....	.....	5½	4	4
5	Tappy & Steel, Petersburg, Va.	.....	.....	.....	.....	4 9/16	4 9/16	2¾
6	Geo. V. Scott & Son, Petersburg, Va.	.....	.....	*$12 75	.....	.....	.....	.....
7	Marks & Friend, Petersburg, Va.	.....	.....	14 00	.....	.....	.....	.....
8	Silas E. Mills, Petersburg, Va.	100 piles to be delivered on or before December 10, 1884, and the rest by January 1, 1885.	95	.....	†08	.....	.....	.....
9	Mayer & Co., Norfolk, Va.	.....	.....	.....	.....	4	*3 9/16	*2¾

* Accepted. † To be dug at United States' expense.

COMMERCIAL STATISTICS.

PETERSBURG, VA., *July* 14, 1885.

DEAR SIR: In accordance with your request I hereby furnish you statistical information of the tonnage of the port of Petersburg, from January 1 to December 31, 1884, and from July 1, 1884, to July 1, 1885, and the commerce of the port for the fiscal year 1884–'85. Table A represents the tonnage of the port for the period named. Table B shows the articles of freight received at or sent from the port by way of Appomattox River, with the values thereof, at the city of Petersburg during the year ending June 30, 1885.

TABLE A.—*Tonnage of the port of Petersburg, from January* 1 *to December* 31, 1884, and *July* 1, 1884, to *July* 1, 1885.

Class.	January 1 to December 31, 1884.		July 1, 1884, to July 1, 1885.	
	Number of vessels.	Tonnage of vessels.	Number of vessels.	Tonnage of vessels.
Schooners	250	29, 827. 12	235	27, 870. 90
Sloops	39	589. 68	39	484. 17
Steamers	204	9, 991. 37	174	6, 411. 68
Steam-tugs	431	5, 641. 86	445	5, 902. 14
Total	924	46, 050. 03	893	40, 668. 89

TABLE B.—*River commerce of the port of Petersburg. Values of articles of freight.*

INWARD FREIGHT.

Articles.	Value.	Articles.	Value.
Coal	$68, 103 00	Potatoes	$2, 826 00
Corn	7, 116 00	Pig-iron	150 00
Wheat	4, 244 00	Sumach	1, 371 00
Oats	2, 488 00	Melons	200 00
Hay, straw, &c	1, 414 00	Bricks	832 00
Ice	36, 032 00	Lumber:	
Guano	381, 905 00	Pine	1, 537 00
Lime:		Poplar	508 00
Builders'	1, 564 00	Sycamore	3, 142 00
Shell	900 00	Oysters	2, 565 00
Salt: Liverpool and ground alum	1, 735 00	Oyster-shells	1, 620 00
Cement	514 00		
Peanuts	9, 020 00	Total	529, 786 00

OUTWARD FREIGHT.

Barrels	$1, 282 00	Lumber—Continued.	
Cotton	52, 915 00	Pine	$56, 139 00
Guano	4, 400 00	Poplar	180 00
Stable manure	438 00	Pine wood	56, 481 00
Wheat	12, 400 00	Poplar wood	2, 911 00
Oats	260 00	Miscellaneous	40, 000 00
Lumber:			
Oak	3, 102 00	Total	230, 508 00

SUMMARY.

Inward commerce	$529, 786 00
Outward commerce	230, 508 00
Total	760, 294 00

In consequence of the past year being a rather dull one in trade throughout the United States, and particularly in this city, the tonnage and commerce of the port of Petersburg fell below the same for the previous year, though the tonnage for the years 1883 and 1884 vary only 20 tons. The tonnage and commerce of the port will undoubtedly be largely augmented when the navigation of the Appomattox River shall

have been improved so as to accommodate the safe and constant passage of vessels of 11 and 12 feet draught.

The city of Petersburg has expended on the Appomattox River from 1825 to 1881 the sum of $538,400, and from 1881 to 1885 $22,500, including $12,500 for a new dredge two years ago, making a sum total of $560,900, and she is engaged at this time in dredging the bars in the channel below the city. Negotiations have been going on between the Lower Appomattox Company, representing the city, and a New York firm, with a view of entering into a contract for the removel of certain rocks in the harbor, which work, it is expected, will be consummated this summer or fall. It is likewise contemplated to carry on dredging operations in the harbor, and also to alter the course of Lieutenant Run, when an appropriation shall have been made by the city council for this object, which will result beneficially to both harbor and city wharf property.

The following statistics are taken from the official records of the United States internal revenue department of Petersburg for the year 1884:

Year.	Tax collected from tobacco manufactured in—			Tobacco manufactured in United States exported, pounds.	Tobacco manufactured in Peterburg exported, pounds.
	United States.	Virginia.	Petersburg.		
1884	$13, 936, 258 99	$2, 706, 615 37	$488, 146 32	10, 637, 603	3, 772, 063

Very respectfully,

E. H. STAINBACK,
Port Warden.

F. A. HINMAN,
Captain of Engineers, U. S. A.

L 4.

IMPROVEMENT OF NOTTOWAY RIVER, VIRGINIA.

There were no operations except to make an examination of the lower 19 miles of the river, which was found to be in fair condition.

There are no reliable commercial statistics available. There is but little traffic over the river.

Nottoway River is in the collection district of Norfolk, Va.

Money statement.

July 1, 1884, amount available	$579 70
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	126 41
July 1, 1885, amount available	453 29

L 5.

IMPROVEMENT OF BLACKWATER RIVER, VIRGINIA.

There were no operations except an incidental examination of the river in connection with the examination of other works in this vicinity. It was found to be generally in good condition. Two bars previously dredged have shoaled slightly, and need redredging, and several projecting points already partially cut off require further attention. Of course any logs, &c., that may be found should be removed.

It is proposed to expend future appropriations in making the improvements noted above.

The commercial statistics received are appended hereto. No more could be obtained although applied for. The headquarters of the Albemarle Steam Navigation Company are at Franklin, on the Blackwater.

The Blackwater River is in the collection district of Norfolk, Va.

Money statement.

Amount (estimated) required for completion of existing project	$850 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	2,500 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

OFFICE OF SUPERINTENDENT
ALBEMARLE STEAM NAVIGATION COMPANY,
Franklin, Va., July 13, 1885.

DEAR SIR: Inclosed I hand you desired statement of our business. It would have been sent earlier but for my absence from home. Other steamers than ours run on these rivers, and handle, I suppose, about 25 per cent. as much stuff as we do. We do not run on Nottoway; nor do we handle lumber, although large quantities are daily shipped from the counties adjacent to these rivers.

Truly, yours,

J. H. BOGART,
Superintendent.

Capt. F. A. HINMAN.

Statement of tonnage performed by the Albemarle Steam Navigation Company at Franklin, Va., from July 1, 1884, *to July* 1, 1885.

Route.	To steamer.			From steamer.			
	Merchandise.	Guano.	Total.	Truck and merchandise.	Cotton.	Fish.	
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Bales.*	**Boxes.*	†*Barrels.*
Chowan River....	10,384,812	3,954,140	14,338,952	4,799,876	9,434	2,550	2,321
Meherrin River..	4,122,376	2,546,320	6,668,696	2,102,528	5,426	.....	.....
	14,507,188	6,500,460	21,007,648	6.902,404	14,860	2,550	2,321

* Fresh fish, 375 pounds per box. † Salt fish; North Carolina corned and roe herring.

L 6.

IMPROVEMENT OF ARCHER'S HOPE RIVER, VIRGINIA.

There were no operations except to examine work done and perform routine office work.

The examination showed that the outer end of the dredged channel has shoaled about one foot while the inner portion remains in good condition.

No reliable commercial statistics are available. However, they are unimportant.

Archer's Hope River is in the collection district of Yorktown, Va.

Money statement.

July 1, 1884, amount available	$125 21
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	79 25
July 1, 1885, amount available	45 96
Amount (estimated) required for completion of existing project	9,400 70
Amount that can be profitably expended in fiscal year ending June 30, 1887	5,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

L 7.

IMPROVEMENT OF NORTH LANDING RIVER, VIRGINIA AND NORTH CAROLINA.

The operation consisted in removing 435 logs and 62 stumps from the channel during January and February, thus clearing it again of obstructions of this character, and maintaining navigation.

The river was also examined and cross-sections made between Beacon 1 and Beacon 4, $4\frac{3}{4}$ miles, to ascertain its condition. Some small shoals have reformed that require redredging to restore the channel. Between the said beacons the 9-foot channel is from 20 to 60 feet wide, and the removal of 28,882 cubic yards of material, measured in place, is required to obtain the full width and depth desired. The details are shown in the following statement:

Location: From Beacon 1 to Beacon 4. Total length, 25,100 feet. Width of cut, 80 feet. Depth at winter stage, 9 feet.

Cubic yards of material removed, measured in scows: 1880, 98,962; 1881, 64,354; total, 163,316.

Condition of channel, 1885: Width, 20 to 60 feet; depth, 9 feet; average width, 45 feet; average depth, 9 feet.

Cubic yards to be removed, measured in place, to make channel 80 feet wide and 9 feet deep: Beacons 1 to 2, 2,171 cubic yards; 2 to 3, 19,484 cubic yards; 3 to 4, 7,227 cubic yards; total, 28,882 cubic yards.

The estimated cost of removing the above material at 25 cents per cubic yard is $7,220.50.

The construction of a combined steam-hoister and pile-driver has been commenced for use on this work and also on the Pamlico and Tar. For the details relative thereto see report for this fiscal year on the latter.

Plans and specifications have been prepared for building a steam-tender for use on this and other works. For the details relative thereto see report for the fiscal year in question on harbor at Norfolk, Virginia, and its approaches.

The foregoing work was done by hired labor and machinery and the purchase of material in open market.

It is proposed to apply future appropriations to dredging as above, and also to the removal of logs and snags that continue to form obstructions. The most of this is due to the careless handling of log-rafts, for which there seems to be no remedy.

The commercial statistics are appended hereto; they also relate to Currituck Sound, Coanjok Bay, and North River Bar, which are on the same inland water-route.

North Landing River is in the collection district of Norfolk, Va.

Money statement.

July 1, 1884, amount available		$5,722 66
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$2,082 94	
July 1, 1885, outstanding liabilities	1,938 44	
		4,021 38
July 1, 1885, amount available		1,701 28
Amount that can be profitably expended in fiscal year ending June 30, 1887 Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		10,000 00

COMMERCIAL STATISTICS.

OFFICE OF THE ALBEMARLE AND CHESAPEAKE CANAL COMPANY,
Norfolk, Va., July 6, 1885.

DEAR SIR: At your request I inclose list of steamers and others vessels navigating Elizabeth and North Landing rivers, via Albemarle and Cheasapeake Canal; also statement of the commercial traffic for the fiscal year ending June 30, 1885.

Very respectfully, your obedient servant,

MARSHALL PARKS,
President.

Capt. F. A. HINMAN,
Corps of Engineers.

List of steamboats navigating North Landing and Elizabeth rivers via Albemarle and Chesapeake Canal for fiscal year ending June 30, 1885.

*Arago.	Greenwich.	Magnolia.
Augusta.	Goldsboro.	M. E. Roberts.
Alfred Spear.	Gipsey.	Mary C.
Bonito.	Helen Smith.	M. E. Dickerman.
*Bramble.	Harbinger.	New Berne.
Bell Virginia.	H. E. Culpeper.	Nettie.
Croatan.	Hamilton.	Norwood.
Currituck.	Hygeia.	Nellie Pryor.
Chowan.	Howard.	N. W. A. Cobb.
*C. B. Phillips.	H. McFadden.	*Nettle.
Cumberland.	*Holly.	Oneida.
Charles Hemje.	I. D. Coleman.	Pierpont.
Conaho.	Ida.	Palermo.
*Dixie.	J. W. Fearing.	Robert Turner.
Discover.	Juniper.	Ranger.
Defiance.	*Jessamine.	R. T. Waters.
E. N. Fairchild.	Kings County.	Remington.
Experiment.	Keystone.	Stewart.
*E. A. Stevens.	Lucy.	Silver Wave.
E. B. Lane.	Lota.	Spring Garden.
Estelle.	Levi Davis.	S. Neilson.
Edith.	*Lookout.	Storm Signal.
Free Canal.	Leila.	Uncle Knapp.
G. H. Stout.	Lumberman.	Virginia.
G. H. Reeves.	Meteor.	*Violet.
G. W. Roper.	Mollie Wentz.	W. T. Taylor.
G. M. Hill.	Manistee.	William Gates.
G. H. Wright.	Monitor.	W. H. Armitage.

Those marked * belong to or employed by United States Government.

Number and class of vessels passed through the Albemarle and Chesapeake Canal for the fiscal year ending June 30, 1885.

Date.	Steamers.	Schooners.	Sloops.	Barges.	Lighters.	Rafts.	Total.
1884.							
July	274	236	42	40	10	20	622
August	266	146	68	50	12	15	557
September	229	57	16	49	18	12	381
October	251	62	5	65	18	14	415
November	273	52	8	71	9	17	430
December	237	41	5	51	16	10	360
1885.							
January	233	75	13	44	7	12	384
February	219	50	5	46	8	11	339
March	246	57	9	66	8	15	401
April	279	79	12	68	10	17	455
May	230	120	11	49	9	21	631
June	239	84	10	34	6	17	390
	2,976	1,059	204	633	131	181	5,365
North	1,488	539	97	318	80	181	2,884
South	1,488	520	107	315	51	.....	2,481
Total	2,976	1,059	204	633	131	181	5,365

OFFICE ALBEMARLE AND CHESAPEAKE CANAL COMPANY,
Norfolk, Va., June 30, 1885.

Trade of the Albemarle and Chesapeake Canal for fiscal year ending June 30, 1885, *passing through Elizabeth and North Landing rivers.*

GOING NORTH.

Articles.	Quantity.	Articles.	Quantity.
Cotton ..... bales..	61,877	Corn ..... bushels..	102,465
Fish ..... barrels..	3,860	Peanuts ..... bags..	16,575
Naval stores ..... do...	8,735	Rice ..... bushels..	20,591
Spirits turpentine ..... do...	72	Wheat ..... do...	8,793
Iron ..... pounds..	366,900	Watermelons	260,027
Eggs ..... crates..	2,229	Lumber ..... feet..	63,284,528
Bacon ..... pounds..	21,020	Shingles	22,362,678
Wood ..... cords..	863	Staves	78,012
Peas ..... bushels..	4,414	Laths	1,702,730
Railroad ties	22,515	Passengers	1,862
Potatoes ..... bushels..	25,939		

GOING SOUTH.

Articles.	Quantity.	Articles.	Quantity.
Bread ..... barrels..	702	Nails ..... kegs..	1,668
Beef and pork ..... do...	8,972	Lime ..... casks..	1,788
Beer and cider ..... do...	407	Oyster shells ..... bushels..	33,675
Flour ..... do...	48,263	Iron ..... pounds..	141,951
Fish ..... do...	1,695	Guano ..... tons..	2,287
Molasses ..... do ..	1,907	Hay ..... bales..	7,007
Liquors ..... do...	1,722	Salt ..... sacks..	7,086
Sugars ..... do ..	5,058	Lime ..... bushels..	30,000
Coffee ..... bags..	1,651	Oil ..... barrels..	2,721
Hats and shoes ..... cases..	2,931	Coal ..... tons..	2,559
Soap and candles ..... boxes..	7,382	Ice ..... do...	3,590
Tobacco ..... do...	2,557	Passengers	1,903
Dry goods ..... cubic feet..	34,432		

L 8.

IMPROVEMENT OF EDENTON BAY, NORTH CAROLINA.

The act of July 5, 1884, appropriated $10,000 for this work. A project for the expenditure thereof was submitted to the Chief of Engineers and duly approved.

In accordance therewith proposals were invited for dredging, and on January 28, 1885, a contract was made with Thomas P. Morgan, esq., the lowest bidder, to do the work at 14 cents per cubic yard, measured in place, and $7 per hour for the time consumed and lost in removing stumps and logs, provided that no charge be made for time consumed in removing stumps or logs blown to pieces by the United States, but only for the time so lost.

Work was to have been commenced under the contract February 23, 1885, but for various causes Mr. Morgan did not begin operations until March 19, 1885. Up to June 30, 1885, he removed an approximate estimate of 29,000 cubic yards. Being unable to complete the contract by the time specified therein—June 30, 1885—he asked for and obtained an extension of the time to August 31, 1885. The total amount to be removed under the contract is 60,943 cubic yards, contingent on the funds available.

The dredging has all been to a depth of 9 feet at ordinary low water, and has resulted in a straight channel 150 feet wide from the 9-foot curve in the bay to the proposed triangular turning-basin, 1,100 feet, the construction of nearly all the turning-basin (about eight acres), and a channel at least 100 feet wide thence in front of the railroad wharf, 1,150 feet, all of which has very materially aided navigation and commerce.

The character of the material dredged was as follows: From the bay in for a distance of 700 feet it was very soft; thence to the turning-basin, 400 feet, it was very hard sand; the material in the turning-basin was generally very soft, and that in front of the railroad wharf was composed of soft mud, roots, and stumps. Six hundred pounds of No. 2 dynamite was used here by the United States in blasting.

The funds available will do a little more of the work yet to be done. It is proposed to apply the funds—$8,000—asked for the fiscal year ending June 30, 1887, to widening the inner channel and enlarging the turning-basin, thus completing the work in accordance with the plan and estimate.

Parties have been requested to furnish commercial statistics, but none have been received. There is, however, a large trade in fish, truck, cotton, &c., centering here, due principally to the Norfolk Southern Railroad.

Edenton Bay is in the collection district of Albemarle, N. C.

Money statement.

Amount appropriated by act approved July 5, 1884		$10,000 00
Amount received from an officer for fuel		49 50
		10,049 50
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$4,216 53	
July 1, 1885, outstanding liabilities	2,090 34	
		6,306 87
July 1, 1885, amount available		3,742 63
Amount (estimated) required for completion of existing project		8,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		8,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals received for dredging in Edenton Bay, North Carolina, opened by Capt. F. A. Hinman, Corps of Engineers, at Norfolk, Va., January 23, 1885.

No.	Names and addresses of bidders.	Date of commencement and completion of work.	Number and kind of machines to be used.	Capacity.	Price per cubic yard.
1	Thomas P. Morgan, Washington, D. C.	According to specifications.	.....	.....	14 cents, and $7 per hour for removal of stumps and logs.
2	Geo. E. Ward, Currituck Court House, N. C.	According to specifications.	One or more dipper dredges.	500 cubic yards per day.	17.7 cents, and $25 each for all stumps over 12 inches in diameter.
3	James Caler & Son, Norfolk, Va.	Commence on or before April 5, 1885, and complete on or before June 30, 1885.	One dipper dredge.	600 cubic yards per day.	16⅔ cents.

Contract with Thomas P. Morgan.

L 9.

IMPROVEMENT OF CURRITUCK SOUND, COANJOK BAY, AND NORTH RIVER BAR, NORTH CAROLINA.

The act of July 5, 1884, appropriated $5,000 for the improvement of Currituck Sound. A project for the expenditure thereof was submitted to the Chief of Engineers and duly approved. In accordance therewith proposals were invited for dredging, and on October 18, 1884, a contract was made with George E. Ward, esq., the lowest bidder, to do the work at 14¼ cents per cubic yard, measured in scows.

Work was to have been commenced under this contract on November 1, 1884, and continued thereafter until completed. Mr. Ward, however, began operations November 12, 1884, and finished the contract May 2, 1885.

During this time he removed 35,000 cubic yards of material from the channel between beacons 6 and 7, all of which materially benefited navigation and commerce.

The entire channel through the sound and bay was cross-sectioned to ascertain its condition, which is shown in the following table:

Location.	Total length.	When dredged.	Width of cut.	Depth at winter stage.	Number of cubic yards of material removed, measured in scows.	Condition of channel, 1885.				Number of cubic yards, measured in place, to be removed to make channel 80 feet wide and 9 feet deep.
						Width.	Depth.	Average width.	Average depth.	
	Feet.		*Feet.*	*Ft.*		*Feet.*	*Ft.*			
Beacons 4 to 5	21,312	1879	52	9	122,890	30 to 70	8	50	8.3	53,909
		1880	52	9	21,259					
Beacons 5 to 6.....	14,560	1880	52	9	89,693	50 to 80	8	60	8.5	36,883
Beacons 6 to 7	12,660	1879	50	9	24,784	20 and 50 to 120	9	110	8.3	15,908
		1880	50	9	32,615					
		1882	80	9	33,127		8			
		1885	80	9	35,000					
Beacons 7 to 8	6,860	1880	50	9	70,475	10 to 70	8	35	8.6	23,846
		1881	80	9	47,808					
Coanjok Bay.....	12,125	1881	40	9	*48,113	10 to 50	8	35	8.3	84,529
		1883	40 to 60	9	*47,518					
										215,075

* This material was, with the exception of a small quantity, measured in place.

To complete the work will require the removal of 215,075 cubic yards of material, measured in place, which at 25 cents, equals $53,768.75.

An examination and map were also made of North River Bar. It is evident that it would be very expensive to improve this bar by means of jetties, it being so large, nor is it likely that there will ever be funds available to so improve it. Fortunately, it is hard and quite constant. It is believed that a dredged channel through it would be maintained by the currents (due almost entirely to the winds), and, also, by steamers, two range lights being properly located to mark the channel. It is accordingly recommended that a straight channel be dredged through it 7,150 feet long, 150 wide, and 9.4 feet deep at ordinary low water, which will require the removal of 37,847 cubic yards of material, measured in place, which, at 30 cents, equals $11,354.10, making a total estimate of $65,122.85 for the completion of this entire work.

The range lights, of different heights and colors, should be gas-beacons like those constructed by the Light-House Department in Currituck Sound and North River. They should be placed inside, on the prolongation of the east side of the proposed channel, and not too far from the bar. The expense of maintaining these lights would probably not be very great, as the said department has the plant near by for manufacturing gas, charging beacons, &c.

Plans and specifications have been prepared for building a steam-tender for use on this and other works. For the details relative thereto see report for this fiscal year on harbor at Norfolk and its approaches, Virginia.

The commercial statistics are the same as those to be found in report on North Landing River for this fiscal year, these works being on the same inland water-route.

Currituck Sound, Coanjok Bay, and North River Bar are in the collection district of Norfolk, Va.

Money statement.

July 1, 1884, amount available	$3,000 50
Amount appropriated by act approved July 5, 1884	5,000 00
	8,000 50
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July, 1884	6,500 00
July 1, 1885, amount available	1,500 50
Amount (estimated) required for completion of existing project	15,213 95
Amount that can be profitably expended in fiscal year ending June 30, 1887	65,122 85
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals received for dredging in Currituck Sound, North Carolina, opened by Capt. F. A. Hinman, Corps of Engineers, at Norfolk, Va., October 6, 1884.

No.	Names and addresses of bidders.	Number and kind of machines to be used.	Capacity per day.	Date of commencement and completion of work.	Rate per cubic yd.
			Cubic yards.		*Cents.*
1	Thomas P. Morgan, Washington, D. C.	One dipper dredge	500	Begin work on October 15, and complete it on or before June 30, 1885.	26
2	H. E. Culpepper, Portsmouth, Va.	One or more of Osgood's patent machines.	300	Commence work on or before November 15, 1884, and complete it as soon as possible.	24
3	George E. Ward, Washington, D. C.	One or more dipper dredges, Osgood's improved.	300	Commence work immediately upon notice of award, and finish on or before April 1, 1885.	14¼
4	James Caler & Son, Norfolk, Va.	One dipper dredge.	.....	Commence work on or before May 1, 1885, and complete it on or before June 30, 1885.	29

Contract with George E. Ward.

L 10.

IMPROVEMENT OF MEHERRIN RIVER, NORTH CAROLINA.

The operations consisted in again clearing the entire navigable portion of the river, 11 miles of obstructions during the month of March. The following were removed: 44 overhanging trees, 12 sunken trees, 57 mill-logs, and 6 snags. This work was done by hired labor and machinery. The river was inspected and found to be in good condition with the exception of two shoals, with a minimum depth of 8 feet of water thereon, that required dredging.

It is proposed to expend future appropriations in dredging and in removing obstructions, like those above, that will continue to form.

A portion of the commercial statistics will be found in report for this fiscal year, on the Black Water River. There are more, as other lines of boats ply there, but they could not be obtained, although applied for.

The Meherrin River is in the second collection district of North Carolina.

Money statement.

July 1, 1884, amount available	$866 10
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	418 50
July 1, 1885, amount available	447 60
Amount (estimated) required for completion of existing project	7,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	7,500 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

L 11.

IMPROVEMENT OF PAMPLICO AND TAR RIVERS, NORTH CAROLINA.

The act of July 5, 1884, appropriated $5,000 for this work. A project for the expenditure thereof was submitted to the Chief of Engineers and duly approved. In accordance therewith proposals were invited for building a combined steam-hoister and pile-driver for use on this work, and also on North Landing River, to be paid for from the funds available for each, share and share alike. All bids received therefor were rejected as excessive, and authority was granted to build the same by hired labor and the purchase of materials in open market. The construction of this has been commenced accordingly. It drew 8 inches when launched and will shortly be finished. It will be provided with pump for water-jet and fully equipped for work.

The following was done by the hire of labor and machinery and the purchase of materials in open market: Commencing at a point 11 miles below Tarborough, the river was cleaned for a distance of 8½ miles, or to within 7 miles of Greenville. For this purpose 650 logs, 106 stumps, 617 snags, 5 bridge-piles, one large sunken flat, and 149 leaning trees were removed.

An examination of the river was made, which shows it to be in the following condition: Of the forty-one jetties twenty-five were in good order, and the balance not. As a rule they have proved of benefit to navigation, but more will be required to complete the project. Some have been damaged by steamers striking them at high water, for which reason piles should be placed at the ends thereof to mark them. The

best jetties are those composed of two rows of piles, filled in with logs, &c. No work has been done on jetties since 1882. There are yet many overhanging trees along this river, and many logs, snags, &c., to be removed. The bridges at Greenville and Sparta collect large quantities of drift, which causes shoals and rapids to form to the detriment of navigation. Clear span-bridges should be substituted therefor. Steamers run regularly from Washington to Greenville the year round, and thence to Tarborough only during high water.

For this fiscal year the following commercial statistics have been received from the Clyde and Old Dominion Steamship Companies:

Bales of cotton		27,054
Rice	barrels..	5,343
Shingles		917,029
Naval stores	barrels..	4,732
Potatoes		8,115
Lumber	feet..	94,686
Miscellaneous packages		22,842
Aggregate tons of merchandise shipped		9,552,697

Money statement.

July 1, 1884, amount available		$2,333 67
Amount appropriated by act approved July 5, 1884		5,000 00
		7,333 67
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$3,749 83	
July 1, 1885, outstanding liabilities	1,120 94	
		4,870 77
July 1, 1885, amount available		2,462 90
Amount that can be profitably expended in fiscal year ending June 30, 1887 Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		5,000 00

Abstract of proposals received for furnishing and delivering a combined steam-hoister and pile-driver for Pamplico and Tar rivers, North Carolina, and North Landing River, Virginia and North Carolina, opened by Capt. F. A. Hinman, Corps of Engineers, at Norfolk, Va., April 17, 1885.

No.	Names and addresses of bidders.	Time for delivery.	Price.
1	Peter H. Brickhead, Toledo, Ohio	According to specifications	$6,200
2	L. G. Ferris, Baltimore, Md	According to specifications	4,375
3	Wm. E. Woodall, Baltimore, Md	In seventy days after acceptance of bid	9,000
4	The Pusey and Jones Company, Wilmington, Del.	According to specifications	6,325

All bids rejected as being excessive.

L 12.

IMPROVEMENT OF YADKIN RIVER, NORTH CAROLINA.

The operations were confined to the 5½ miles of the river-front from Barnes's Shoal up to Swicegood's Mill Dam.

At Barnes's Shoal one wing-dam was completed and four more built, aggregating 365 linear feet; at Big Rock Shoal 513 cubic yards of rock were blasted and removed from the channel, a portion being used for a revetment along the left bank, and the balance for a dam 110 feet long across

the upper part of the shoal; at Hairston's Ferry a number of bowlders were removed from the channel, and just above here six wing-dams were built in pairs opposite to each other, aggregating 585 feet in length. These are composed of rock and brush; but little of the latter had been used in dams heretofore. From Swicegood's Mill Dam a training-wall was built down-stream, generally in the middle of the river, for a distance of 750 feet, composed of logs, brush, and rock, and six wing-dams, aggregating 328 linear feet, built in relation to same, which, in connection with similar work proposed, is intended to carry the channel over Swicegood's Mill Dam at the north end without injury to the water-power, but on the contrary improving it incidentally. A total of 2,138 linear feet of wing-dams and training-wall was built. Field-work closed for the season December 2, 1884, on account of cold weather, and was not resumed again during the fiscal year ending June 30, 1885, there being no approved project for the expenditure of the funds available. This work was done by the hire of labor, the purchase of material in open market, and the use of the United States plant.

The act of July 5, 1884, provided as follows:

> That the sum of $6,000, authorized by the act approved June 14, 1880, to be expended for the removal of dams in Yadkin River, North Carolina, may be used by the Secretary of War for acquiring the right of way, by removal or otherwise, of such dams as may be necessary for the contemplated improvement, the said right of way or removal to be obtained by agreement with the parties interested, or, in event of failure to make a reasonable agreement, by condemnation, as provided for by the laws of the State of North Carolina.

It is questionable whether the expenditure of any of this sum will be necessary, as recent investigations show that the dams can all be best and most economically passed by using dams and training-walls, or by locks, as the case may be. Accordingly, this amount will be held for the present. It would be very expensive to make low-water navigation on this river in any manner; the commerce to be developed would not justify it.

On June 20, 1885, the Chief of Engineers approved the recommendation made in the project submitted January 6, 1885, that the balance of the funds available, aside from the $6,000 reserved for acquiring the right of way by removal or otherwise of dams, be applied to improving the river at Swicegood's Mill Dam, Dutchman's Island, Boon's Ford Shoal, reef below Fulton, Peebles' Dam, Peebles' Reef, and Hartley's Dam, in the order named, for navigation at *winter stages*. Accordingly, needed repairs to the plant were commenced, and work will be resumed at Swicegood's Mill Dam shortly.

No commerce existed upon the river before the commencement of the improvement, and none has been developed by it thus far.

The overseer on the work reports the following commercial statistics under date of July 4, 1885:

> In reply to your inquiry in reference to commercial statistics of that country lying along the Yadkin River, from the North Carolina Railroad Bridge to foot of Bean's Shoals, I have the honor to make the following statement: Last year's corn crop was considerably short of the year previous. The wheat crop of 1884 and 1885 is hardly more than half of 1883 and 1884. There has been a marked increase in the tobacco crop. Very little of the corn made in this section would be carried out except in whisky, and possibly Davie, Davidson, and Rowan counties receive from the western market from 12,000 to 15,000 bushels of corn, which is distilled. There are also about 2,000 bushels of rye brought from the west for the same purpose. The demand for western corn in my own section has been very strong, and much of it would have been sold here but for the want of railroad facilities or transferring from railroad to boat at railroad bridge.

The agricultural products of above-named section are:

Indian corn	bushels..	448,284
Wheat	do....	106,423
Rye	do....	5,636
Oats	do....	40,450
Tobacco	pounds..	2,400,000
Cotton (exclusive of Rowan)	bales..	1,800

* * * * * * * *

The Yadkin River is in the sixth collection district of North Carolina.

Money statement.

July 1, 1884, amount available		$23,298 60
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884		8,574 65
July 1, 1885, amount available		14,723 95
Amount that can be profitably expended in fiscal year ending June 30, 1887 Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		10,000 00

L 13.

IMPROVEMENT OF SCUPPERNONG RIVER, NORTH CAROLINA.

The act of July 5, 1884, appropriated $2,000 for this work. An examination of the river was made preliminary to the resumption of operations, but there were none, as the work was not urgent and the plant to be employed on it was engaged elsewhere. A party is now (July 15) engaged in completing the improvement.

Commercial statistics have been sought for, but none obtained. Two steamers run regularly on the river and do an extensive business.

The Scuppernong River is in the collection district of Albemarle, N. C.

Money statement.

Amount appropriated by act approved July 5, 1884		$2,000 00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$23 12	
July 1, 1885, outstanding liabilities	97 55	
		120 67
July 1, 1885, amount available		1,879 33

L 14.

REMOVING SUNKEN VESSELS OR CRAFT OBSTRUCTING OR ENDANGERING NAVIGATION.

A recent examination of the Scuppernong River, North Carolina, disclosed the fact that navigation was seriously obstructed by the wreck of the schooner Lawrence, lying in a narrow bend near Spruill's Bridge. She had sunk from neglect to pump her out; had been there for over a year, and no one seemed inclined to remove her, although it could have been done easily. All the steamboat men greatly desired her removal, but did not know how to effect it. It is understood that the authorities of Washington County, North Carolina, were asked to do it but declined.

As the ownership of her could not be ascertained, she was duly advertised under the law.

S. S. Simmons, esq., of Creswell, N. C., claims some interest in her, and has promised to pay for the advertising and to remove her very soon without expense to the United States.

L 15.

PRELIMINARY EXAMINATION OF PERQUIMANS RIVER ABOVE HARTFORT [HERTFORD], NORTH CAROLINA.

UNITED STATES ENGINEER OFFICE,
Norfolk, Va., October 31, 1884.

GENERAL: In accordance with your instructions of the 4th ultimo, I have the honor to submit the following report upon a preliminary examination of "Perquimans River above Hartfort [Hertford], N. C.," made under my direction by Mr. George H. Elliott, assistant engineer.

It is believed that his report thereon, transmitted herewith, gives the information desired. The conclusions arrived at therein are indorsed by me.

Very respectfully, your obedient servant,

F. A. HINMAN,
Captain of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

REPORT OF MR. GEORGE H. ELLIOTT, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Norfolk, Va., October 31, 1884.

CAPTAIN: I have the honor to submit the following report on a preliminary examination of "Perquimans River above Hartfort [Hertford], N. C.," made from October 29 to October 31, in compliance with your verbal instructions.

For perhaps 10 miles above Hertford the river, although crooked, has a width of from 300 to 500 feet, and a sufficient depth of water for any vessels that can reach that place. In this portion there are some stumps. There are also three landings from which produce is shipped, viz, Twine's, 4 miles; Thatcher's, 5 miles; and Blanchard's, 6 miles above Hertford. A mile above Blanchard's are a number of very bad bends, known as the "Roundabouts." At the upper end of this portion is an island forming two channels, which are tortuous; therefore a "thoroughfare" some 60 feet long and 50 feet wide is used preferably by vessels.

Above the "thoroughfare" the river narrows and is more crooked up to Newby's Bridge, the head of navigation, presenting a succession of very sharp bends, around which a steamer 105 feet long cannot pass without stopping frequently to back, pole, &c. There are two landings on this portion, viz, Newby's Bridge and Darden's Wharf, from both of which large quantities of cotton, rice, and other produce are shipped. Between these points, a distance of about 3 miles, the steamboat owners have made two short cuts through points at abrupt bends. In this portion of the river are a few stumps, and at the island and two other places the channel is exceedingly narrow, owing to points projecting nearly across. There are also a few overhanging trees. The steamboat employés report that they trimmed most of the banks a few years ago.

The chief obstructions to the navigation of this river are the bends, and it cannot be improved except by making cuts at numerous points, the location of which can best be determined after an accurate survey, which it is estimated will cost $400 to make.

It is questionable whether the commerce involved is commensurate with the probable expense of making the necessary improvement, and I therefore do not consider it as worthy of improvement from a commercial point of view, but only from a purely engineering standpoint.

Mr. W. Y. Johnson's letter to me of August 13 last, relative to this matter, is transmitted herewith.

Very respectfully, your obedient servant,

GEO. H. ELLIOTT,
Assistant Engineer.

Capt. F. A. HINMAN,
Corps of Engineers, U. S. A.

LETTER OF MR. W. Y. JOHNSON.

[W. Y. Johnson, Commerce Street Wharf, agent for steamer Harbinger, Perquimans River Line; steamer Currituck, Windsor Line; steamer Keystone, F. and M. S. T. Co.; steamer Helen Smith, N. R. S. T. Co.]

NORFOLK, VA., *August* 13, 1884.

DEAR SIR: Yours of the 11th instant, asking information regarding the Perquimans River, received, and in reply would state that the said river is in a very navigable condition as far up as the place known as the "Thoroughfare." Above that point it is very crooked and narrow, and it is with difficulty that any boats can get to what is known as Newby's Bridge, a distance of 6 miles. All the produce from Gates, Chowan, and the upper end of Perquimans counties comes to this point and Darden's Wharf (about 3 miles below) for shipment.

All that is needed to make this part of the river passably navigable is to have the points cut off from the "Thoroughfare" to Newby's Bridge. There is no lack of water, there being from 15 to 20 feet depth of water. This is about the condition of the river at the upper end.

Respectfully, yours,

WOODS P. JOHNSON,
For W. Y. JOHNSON, *Agent.*

GEORGE H. ELLIOTT, Esq.,
United States Assistant Engineer.

L 16.

PRELIMINARY EXAMINATION OF GREEN RIVER, NORTH CAROLINA.

UNITED STATES ENGINEER OFFICE,
Norfolk, Va., October 17, 1884.

GENERAL: In accordance with your letter of the 4th ultimo, I have the honor to submit the following report of the preliminary examination of Green River, North Carolina, made by myself on the 10th, 11th, and 12th instants.

This river, located in the southwestern portion of the State, rises in the Blue Ridge Mountains, in Henderson County. It is very tortuous in its course, except for a mile near its mouth, turning abruptly and running in every direction, but its general course is northeast, east, and southeast.

It flows from Henderson County into Polk County, close to the Rutherford County line, and empties into Broad River, near the South Carolina boundary.

The river was very low at the time of my examination, as there had been no rain of any consequence for several months in its vicinity. It has all the characteristics of a mountain stream, abounding in rock ledges, bowlders, gravel bars, falls, rapids, pools, &c. The fluctuations between high and low water are from 12 to 20 feet, depending on the

locality, and very sudden indeed. "Fish-traps" have been built on the ledges in many places.

I examined the river no higher up than where it is crossed by the railroad from Spartanburg to Hendersonville, at which point it was 50 feet wide and very shoal. Between here and Maj. J. M. Hamilton's, at Bright's Creek, on the Mills Gap Road, a distance of some 25 miles, I examined it at various points in the mountains as I passed along in a wagon, there being not water enough to go by skiff. I forded it on the Howard's Gap Road, the bridge being bad and also a number of times below, near Green River Cove. It is also forded at various points to the mouth.

At Major Hamilton's I procured a pole-barge (used for crossing the river) 18 by 3 feet, that drew 6 inches with three men in it. In this I passed down the river to its mouth with great difficulty, the estimated distance being 35 miles, the width from 30 to 120 feet, the estimated fall 350 feet, and the number of rock-ledges that crossed the river seventy-five by actual count, from 3 inches to 4 feet in height, estimated. "High Fall" is the greatest and Waldrop's Mill-Dam (the only one on the river) the next. There were also ten gravel bars crossing it. I sounded the river frequently and found the depth from a few inches to 4 feet, depending on the location—on ledges or in pools.

The freshet of last June was very destructive, the high bridge at Bright's Creek being carried away, and also much of the crops on bottom lands.

Three bridges now cross the river, viz: Hon. R. L. Hamilton's, 20 miles (by river) below Major Hamilton's; Cox's; and Smalley's. Cox's is one span, about 90 feet long and 20 feet above low water. The others are heavy, low bridges, constructed to withstand freshets over them, the bridge floors inclining up stream a little.

The mountain sides are covered with valuable timber, some of which overhangs the channel.

This river has no affluent of any importance except White Oak Creek, which comes in on the right bank, near the mouth.

There is but little cultivated land along the river, except the bottom lands along the middle portion, of which there are a few acres here and there, and considerable at the lower end.

Wheat, corn, tobacco, sorghum, cotton, apples, peaches, &c., are the principal crops. "The present and prospective demands of commerce" are not large. The river, of course, could be made to afford fine water-power.

In connection with this matter I quote as follows from report, dated January 27, 1883, of Capt. James Mercur, Corps of Engineers (now professor of engineering at West Point), printed in Senate Ex. Doc. No. 30, Forty-eighth Congress, first session, and entitled "Report in reference to preliminary examination of Broad River from Rutherfordton, N. C., to South Carolina line":

* * * * * * *

This river having been examined, under direction of Lieutenant-Colonel Gillmore, by Mr. J. P. Carson, assistant engineer, and a report, with estimates for improvement, having been published in the Report of the Chief of Engineers for 1880, pages 1010 to 1032, no preliminary examination is considered necessary.

Your attention is respectfully invited to this report, which shows that that part of the river from the head of navigation at its junction with the Green River, about 8½ miles from Rutherfordton, to a point 46¾ miles below (or about 20 miles below the South Carolina line), would be the most difficult and most expensive portion to improve.

Lieutenant-Colonel Gillmore, in his report upon the whole river, says that—

"From the information before me I am not prepared to say that there is any urgent necessity for this improvement."

From the experience obtained in the improvement of similar rivers in North Carolina, I am convinced that the estimates for the upper part of this would have to be materially increased, even to secure a pole-boat navigation; and, as the statistics show such a marked decrease in the amount of freight carried by the river over that carried in former years, this part of the river is not, in my judgment, worthy of improvement, and the work is not a public necessity.

I transmit herewith letters on this subject to the late Mr. W. H. James, assistant engineer, as follows:

Letter from Hon. R. B. Vance, M. C., dated August 23, 1884.

Letter from General Thomas L. Clingman, ex-United States Senator, dated August 18, 1884.

Letter from W. V. Perrin, esq., dated August 29, 1884.

I wrote Mr. J. C. McFarland, of Columbus, N. C., for information, but the letter was returned "uncalled for."

Hon. R. L. Hamilton, county commissioner of Polk County, accompanied me in the barge down the river, and gave me much information of value. The trip was a novel one to him. He has resided on the river for many years, and has never heard of any one having attempted the trip before. Old residents were surprised that it could be made.

In conclusion, I respectfully report that Green River, North Carolina, is, in my opinion, not "worthy of improvement" for purposes of navigation; the foregoing giving "fully and particularly the facts and reasons on which such opinion is based."

Very respectfully, your obedient servant,

F. A. HINMAN,
Captain of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

LETTER OF HON. ROBERT B. VANCE, M. C.

ASHEVILLE, N. C., *August* 23, 1884.

DEAR SIR: I wrote J. C. McFarland, esq., Columbus, N. C., to inform you fully as to Green River. The river rises perhaps in Henderson and runs through Polk County. I think the survey need not go above railroad bridge across the river (the Spartanburg and Asheville Railroad), and perhaps not above the wood bridge on the old dirt road from Polk to Henderson and Buncombe counties.

I suppose 2½ feet of water will be all that is expected, so as to enable a boat of light draught to go up and down, Wing-dams in places may be necessary. I hope Mr. McFarland will inform you fully.

Truly,

ROBT. B. VANCE.

WM. H. JAMES, Esq.

LETTER OF HON. THOMAS L. CLINGMAN.

ASHEVILLE, N. C., *August* 18, 1884.

DEAR SIR: Your letter has been received, and in reply to your inquiry I will say that Hendersonville will be a convenient point from which to examine Green River. I am not sure that I understand fully the object of your inquiries. If the purpose is to ascertain the advantages of the river for manufacturing purposes—I mean factory sites—I can commend it. From a point south of Hendersonville the river probably falls 1,000 feet within 20 miles. I am told that one of the falls is as much as 75 feet, and there are many smaller ones. Though it is a small mountain stream, it has water enough for factories of ordinary size.

The suggestion that it would be a suitable stream for navigation purposes is merely laughable, though some kinds of fish are found in it.

Respectfully, yours, &c., T. L. CLINGMAN.

WM. H. JAMES, Esq.

LETTER OF MR. W. V. PERRIN.

WHITE OAK HALL, N. C., *August* 29, 1884.

DEAR SIR: As I understand, the request for the survey of Green River was made on the reports of engineers' reports of the survey of Broad River, as it was then understood (about two years since), that it was navigable for small steamers as high as James Harris's, in Rutherford County.

Several of our citizens, knowing both rivers, were impressed with the more than feasibility of running them up Green River, and that if Broad River should be improved they then would have a water outlet, and it was with that contingency that they asked the survey.

If the survey is to be made, they (the engineers) should commence at the junction of Green and Broad rivers, near Poor's Ford, in Rutherford County, 23 miles northeast of Spartanburg, S. C., then up said river a distance of 16 or 18 miles as it meanders.

Very respectfully,

W. V. PERRIN.

Hon. ROBERT B. VANCE.

[Indorsement.]

Forwarded with regards.

ROBT. B. VANCE.

L 17.

PRELIMINARY EXAMINATION OF PASQUOTANK RIVER, ABOVE MOUTH OF CANAL, NORTH CAROLINA.

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., January 13, 1885.

SIR: I have the honor to submit herewith a copy of a report to this office, with accompanying papers, from Capt. F. A. Hinman, Corps of Engineers, of the results of a preliminary examination made in compliance with requirements of the river and harbor act of July 5, 1884, of Pasquotank River, North Carolina, in the vicinity of the outlet of the Dismal Swamp Canal.

The provision of the act relative to this examination reads "Pasquotank River above mouth of canal," where doubtless "below the mouth" was meant.

The Pasquotank leads from the southern terminus of the canal to Albemarle Sound, and the canal company has constructed, for free navigation, at a cost of $50,000, a straight canal, 4½ miles long, called Turner's Cut, to better connect with deep water in the river, as well as to cut off the circuitous route of 8 miles by the river immediately below the outlet lock.

The superintendent of the canal disclaims, on the part of the company, any ownership of Turner's Cut, and views it, its navigation being ree, as navigable waters of the United States.

The improvement of the Pasquotank above the lower end of Turner's Cut is not required, it being a part of the river now never used, for which the cut-off was substituted. It appears that the improvement desired is that of the cut itself, which Captain Hinman reports is worthy of improvement. But the wording of the act being explicit in restricting the examination to the Pasquotank River, in view of the question of the ownership of Turner's Cut, as well as the want of au-

thority of law to survey this adjunct of the canal, I have not considered myself authorized to direct such a survey to be made as the law now stands.

Very respectfully, your obedient servant,

JOHN NEWTON,
Chief of Engineers,
Brig. and Bvt. Maj. Gen.

Hon. ROBERT T. LINCOLN,
Secretary of War.

REPORT OF CAPTAIN F. A. HINMAN, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Norfolk, Va., August 27, 1884.

GENERAL: In compliance with your instructions of the 31st ultimo I have the honor to submit the following report relative to the examination of the "Pasquotank River, above mouth of canal," North Carolina, provided for by the river and harbor act of July 5, 1884.

I respectfully transmit herewith the following documents relative to the locality under consideration:

(1) Three letters from Mr. Henry Roberts, superintendent of the Dismal Swamp Canal Company, to me, dated the 8th, 14th, and 16th instant, respectively.

(2) Letter-press copy of a letter from Mr. Henry Roberts to Mr. J. C. Reeder, dated "February 27, 1883," that accompanied his said letter of the 16th instant.

(3) *Extract from report dated January 15, 1880, of the late Capt. Charles B. Phillips, Corps of Engineers, entitled "Examination and survey of inland water routes from Norfolk Harbor, Virginia, to the Atlantic Ocean south of Hatteras, including communication with Cape Fear River, North Carolina." (Report of the Chief of Engineers, 1880, pages 851 to 896.)

(4) *Tracing of Turner's Cut from map of same made to accompany report described in 3.

(5) Statements of inward and outward receipts of freight* and number and class of vessels passed through the Dismal Swamp Canal for the fiscal year ending September, 1883, by S. W. Gary, collector, and handed to me by Mr. Henry Roberts.

On the 24th of last April I passed up the Pasquotank River to Turner's Cut, and thence through Turner's Cut and the Dismal Swamp Canal, and am therefore familiar with the locality under consideration.

It appears from the foregoing that there may be some question as to where the "mouth" is, as Turner's Cut may possibly be considered a part of the Dismal Swamp Canal, having been built and being maintained by it, as stated by Mr. Roberts. The mouth is either at the upper end of Turner's Cut or at its lower end. At all events, the portion of the Pasquotank River above the lower end of Turner's Cut is not worthy of improvement; in fact, it is not known that any one desires its improvement, but rather that of Turner's Cut itself, which has been substituted for that part of it called "Moccasin Track," formerly in use and not considered worth improving. If the mouth be at the head of Turner's Cut, as stated by Mr. Roberts, then certainly no work is de-

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*Omitted.

sired or required in the portion of the Pasquotank River above it. The law relative to this examination reads "above mouth of canal." Mr. Roberts states that the petition was to have an examination made "below the mouth of the canal." It is very evident that Turner's Cut is the locality desired by parties interested to be examined, as stated by Mr. Roberts. It is presumed that the ownership of it is not in question for this purpose.

In view of the foregoing I have to report that Turner's Cut, $4\frac{21}{100}$ miles in length, is worthy of improvement, and estimate that $100 is the least amount that will enable me to make a re-survey of it, including a project and estimate for its improvement, if it be so contemplated by the act. A re-survey will be required, as changes have probably occurred since the last one made in 1878 and 1879.

Very respectfully, your obedient servant,

F. A. HINMAN,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

LETTERS OF THE SUPERINTENDENT OF THE DISMAL SWAMP CANAL COMPANY.

1.

OFFICE SUPERINTENDENT DISMAL SWAMP CANAL,
Norfolk, Va., August 8, 1884.

DEAR SIR: In accordance with the act of July 5, 1884, the honorable Secretary of War is hereby directed, at his discretion, to cause examination or survey, or both, to be made and estimate the cost of improvements to be made at the following points, namely:

1. Pasquotank River, North Carolina. I would respectfully suggest, in consequence of the sinuous course of the said river and its impediments of roots, stumps, &c., that this appropriation be put upon Turner's Cut, made by the canal company for *free navigation* to avoid said obstacles, for this reason, that the river is 8 miles long and the cut 4.21 miles less distance, and in every respect better navigation than practically can be made in the river and better calculated to meet the purpose of the improvement. The improvements needed in Turner's Cut will embrace about 1 mile dredging by 40 feet wide and 4 feet deep; probable cost of dredging, 25 cents per cubic yard.

I cannot estimate the cost of any improvement in the river, but I am confident that a large amount will be required to clear it of the shoals, stumps, and logs which now obstruct navigation; in my opinion nothing can be done to make it equal to Turner's Cut.

Very respectfully.

HENRY ROBERTS,
Superintendent Dismal Swamp Canal.

Capt. F. A. HINMAN,
Engineer, U. S. A.

2.

NORFOLK, VA., *August* 14, 1884.

DEAR SIR: Replying to your letter of inquiry of the 11th instant, I have to say as follows:

(1) Hon. T. J. Skinner, M. C., presented a petition, signed by several hundred people along the Dismal Swamp Canal, to have an examination or survey, or both, made of the Pasquotank River, below mouth of the canal. No specific work was asked for; only general improvement.

(2) The mouth of the canal is where it joins the Pasquotank River just below South Locks, or at the head of Turner's Cut. The Dismal Swamp Canal was constructed to connect the Pasquotank and Elizabeth rivers.

(3) The nature of the Pasquotank River above the mouth of the canal is unnavigable, and no one desires its improvement.

(4) The nature of the Pasquotank River above Turner's Cut is the same as stated in 3.

(5) Turner's Cut was built by the Dismal Swamp Canal Company, at a cost of $50,000, for free navigation, to avoid "Moccasin Track," which is unnavigable, and

to better connect the Dismal Swamp Canal with deep water in Pasquotank River. No one claims it, but the Dismal Swamp Canal Company has maintained it to date. There is no deed of it on record.

The wording of the act is "above the mouth of the canal." It should have been *below* the mouth of the canal, as Turner's Cut is not considered a part of the canal.

Yours truly,

HENRY ROBERTS.
Superintendent Dismal Swamp Canal Company.

Capt. F. A. HINMAN, *Corps of Engineers.*

3.

OFFICE SUPERINTENDENT DISMAL SWAMP CANAL,
Norfolk, Va., August 16, 1884.

DEAR SIR: As there may be a question raised in regard to the ownership of Turner's Cut, in order to show how I have always regarded it, I beg leave to inclose a copy of a letter written some time before the application for improvements were made, and before I had any idea that it would be made.

Yours truly,

HENRY ROBERTS,
Superintendent Dismal Swamp Canal.

Capt. F. A. HINMAN, *Engineer, U. S. A.*

LETTER OF THE SUPERINTENDENT OF THE DISMAL SWAMP CANAL COMPANY TO MR. J. C. REEDER.

FEBRUARY 27, 1883.

DEAR SIR: I learn that several parties allow their rafts and logs to lay a very long time in Turner's Cut, and that some of them have sunk, thereby endangering navigation. Please inform the owners of these rafts that if damage is done to vessels passing through the cut by their sunken logs the owners will be prosecuted in the United States courts. Turner's Cut comes under the head of "waters of the United States." These gentlemen will find that they have not the Dismal Swamp Canal to deal with. They certainly will be reported if they continue this practice.

Attend to this matter and report when you have done so.

Respectfully,

HENRY ROBERTS, *Superintendent.*

MR. J. C. REEDER.

Report of the number and class of vessels passed through the Dismal Swamp Canal for the fiscal year ending September, 1883.

Month.	Steamers.	Schooners.	Sloops.	Lighters.	Boats.	Rafts.	Total.
1882.							
October	26	.....	6	36	.....	2	70
November	28	5	2	54	.....	2	91
December	28	6	1	45	.....	3	83
1883.							
January	27	12	6	38	.....	1	84
February	25	25	7	68	1	1	127
March	27	21	.....	82	1	2	133
April	27	20	1	54	.....	2	104
May	28	7	2	44	.....	1	82
June	26	10	4	73	1	5	119
July	26	4	10	62	2	11	115
August	27	3	6	60	2	3	101
September	26	5	1	51	.....	3	86
Total	321	118	46	667	7	36	1,195
North	168	102	37	648	6	36	997
South	153	16	9	19	1	.....	198
Total	321	118	46	667	7	36	1,195

S. W. GARY, *Collector.*

L 18.

PRELIMINARY EXAMINATION OF CASHIE RIVER, FROM ITS MOUTH TO THE TOWN OF WINDSOR, IN BERTIE COUNTY, NORTH CAROLINA.

UNITED STATES ENGINEER OFFICE,
Norfolk, Va., October 31, 1884.

GENERAL: In compliance with your letter of the 4th ultimo, I have the honor to submit the following report upon a preliminary examination of the "Cashie River, from its mouth to the town of Windsor, in Bertie County, North Carolina," made under my direction by Mr. H. C. Collins, assistant engineer. It is thought that his report thereon, accompanying this, furnishes the desired information. The views set forth therein are concurred in by me.

A letter dated August 13th last, from Mr. Howard N. Johnson, relative to this matter, is transmitted herewith.

Very respectfully, your obedient servant,

F. A. HINMAN,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

REPORT OF MR. H. C. COLLINS, ASSISTANT ENGINEER.

EDENTON, N. C., *October* 30, 1884.

CAPTAIN: I have the honor to submit the following report on a preliminary examination of Cashie River, N. C., made under your direction.

I went from Plymouth, by the steamer Bertie, to Windsor, yesterday, passing through the "Thoroughfare," between the Roanoke and Cashie rivers, which is about 2½ miles long, and reached Windsor soon after dark. This morning I passed down the river from Windsor to its mouth on the steamer Cleopatra.

The Thoroughfare is somewhat obstructed by a pile-blockade made during the war, by a wreck, and by quite a number of overhanging trees. From its mouth, where it enters the Cashie, up to Johnson's saw-mill, the river is wide, with water nowhere less than 10 feet deep in the channel, and with only a few snags and overhanging trees. The 10 miles of river from the said mill up to Windsor is narrow, very crooked, and has many sunken logs and trees, as well as an almost continuous line of overhanging trees on either side, which should be removed. From the Thoroughfare down to the mouth of the river there are many flats, but the channel is everywhere good. The most important landing on the lower part of the river is on a little side channel, a mile from the main river, and badly obstructed by overhanging trees. Steamers go to this landing but once a week, on account of the difficulty of reaching it. It is the only landing of a large settlement. At the mouth of the river, for 3 miles out into Albemarle Sound, the channel is much obstructed by logs, snags, and stumps. This approach, the little side channel, the Thoroughfare, and the Cashie River proper, below Windsor, are 40 miles long in the aggregate. There are engaged in the commerce of this river the steamer Bertie, which makes a round trip daily between Plymouth and Windsor, the steamer Cleopatra, which makes four trips weekly on the same route and does job work in addition, and the steamers Currituck and George H. Reeves, which make regular weekly round trips between Norfolk and Windsor. There are also three propeller tugs constantly towing rafts, schooners, and barges, and a steam barge towing two other barges, all of which are engaged in the lumber trade. In addition to these are also occasional steamers coming into the river for lumber or produce, and a large number of small schooners running there constantly.

With the introduction of truck-farming, which is now taking the place of cotton, more transportation will be needed and the removal of obstructions will be the more necessary. The river below Windsor is certainly worthy of improvement.

It is estimated that $800 is the least amount that a survey of this river can be made for on which to base a project and estimates of cost of improvement proper to be made.

Very respectfully, your obedient servant,

H. C. COLLINS,
Assistant Engineer.

Capt. F. A. HINMAN,
Corps of Engineers.

LETTER OF MR. HOWARD N. JOHNSON.

[Greenleaf Johnson & Son, lumber manufacturers.]

NORFOLK, VA., *August* 13, 1884.

DEAR SIR: Yours of August 12 at hand. At the mouth of the Cashie River there are a great many stumps of old trees, leaving a channel of about 8 or 9 feet deep and 50 or 75 yards wide. There is said to be deeper water among the stumps than in this channel. After you get over this place there is plenty of water and good navigation for 25 or 30 miles. Then there is about 10 miles until you get to Windsor, of very narrow and crooked work, where all steamers must run slow, and oftentimes stop and back to get around the bends.

About 6 miles from the mouth of the river is a thoroughfare from the Cashie to the Roanoke River, which was closed by the Confederates during the war. This is partially opened now and is used by steamers running from the Cashie to any point on the Roanoke, as it saves them from going out one river and up the other, probably a distance of 24 miles.

I would be glad to be of any assistance possible, such as showing your assistant over the route, &c.

One of our steamers could take your assistant over the route, leaving him at Windsor, at the head of navigation, to return by the Norfolk and Southern Railroad, or he could take the Norfolk and Southern Railroad, connect with the steamer Bertie at Plymouth, go up the Roanoke River, and through this thoroughfare to Windsor, returning the next day by the steamer Cleopatra down the river, and out over the stumps at the mouth.

Very respectfully, &c.,

HOWARD N. JOHNSON.

Capt. F. A. HINMAN.

SURVEY OF CASHIE RIVER, FROM ITS MOUTH TO THE TOWN OF WINDSOR, IN BERTIE COUNTY, NORTH CAROLINA.

UNITED STATES ENGINEER OFFICE,

Norfolk, Va., January 26, 1885.

GENERAL: I have the honor to submit the following report on the survey of the "Cashie River from its mouth to the town of Windsor, in Bertie County, North Carolina," made in accordance with your instructions of November 21 last.

The field work of this survey was done by Mr. H. C. Collins, assistant engineer. A copy of his report on same is forwarded herewith; also tracings* of maps of same, consisting of one general map, five detailed sheets, and two cross section sheets.

The relative positions of the Cashie and Roanoke rivers and their connections are shown on the general map, a portion of which has been reduced for this purpose from the Coast Survey map of the "Mouths of Roanoke River," 1864. The portion below the "Thoroughfare" is evidently the delta of the Roanoke. Just above the "Thoroughfare" are found the remains of mound-builders, mounds, pottery, flints, &c.

On the Coast Survey map a small portion of the river under consideration is shown and called "Cashai," but the common name for it now is "Cashie," which is pronounced in the vicinity of the river as if spelled K-shy, with the accent on the last syllable.

Having carefully supervised the preparation of Mr. Collins's report and furnished data for the estimates therein, I state as follows:

It is believed that Mr. Collins has gone over the whole subject thoroughly, that his report well portrays the characteristics of the river, and that the views therein expressed can be relied on. His "project, with estimate of cost of improvement proper to be made," and the information

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* Omitted.

given "in regard to the present and prospective demands of commerce," are all approved by me.

There is no navigation above Windsor. From this point the general course of the river is southeast for 17 miles to the "Thoroughfare," and thence northeast to its mouth at the west end of Albemarle Sound. The distance from Windsor to its mouth is 25 miles by river and half this distance in a straight line.

The river is virtually an estuary of Albemarle Sound, except in times of freshet, when there is a rise of about 3 feet. It is from 90 to 1,280 feet wide, with a ruling depth of 8 feet and upward at low water.

The obstructions to navigation consist solely of (1) overhanging growth, snags, saw-logs, &c., and (2) two wrecks partly in the channel near Windsor. Were the former removed the bends could be easily made by steamers. No dredging is required anywhere.

The business along the river consists of lumbering to a large extent, extensive fishing in the season, and considerable farming, for all of which it is the sole outlet.

The improvement of the river should consist in removing overhanging growth, snags, saw-logs, &c., and the two wrecks from the channel, at an estimated cost of $25,560, provided the plant of some other work be available for this (which is very doubtful). If not, then $4,000 must be added thereto for a plant, making the cost of the improvement $29,560; in round numbers, $30,000.

The wrecks are of no value, but should be duly advertised before removal, as well as the logs, which are of some value. The proceeds from the sale of the latter will, of course, reduce the above estimate.

Work of this character cannot well be done by contract, as it does not admit of exact specifications. It should be done by hired labor, and the aid of a United States plant. It is strongly recommended that no work be done on this river until there be assurance that it will be permanent so far as the present practice of wantonly obstructing it by logs and trees is concerned. This, of course, can only be had by proper legislation rigidly enforced.

The "Thoroughfare" and Coshoke Creek are natural navigable adjuncts of this river. The former an important one, 2¼ miles in length, enters the Cashie from the Roanoke at the right bank, 17½ miles below Windsor, and the latter, 1 mile long, joins it at the left, 24 miles below the same point, or near the mouth.

To improve the "Thoroughfare" requires the removal of a number of overhanging trees, one wreck of no value, and also a few of the piles and snags that formed a blockade during the late war. The ruling depth is 10 feet.

The improvement of Coshoke Creek should consist in removing snags and overhanging growth. The least depth is 7 feet, on the bar at the mouth, which is soft. Above this it is 9 feet and upward. The estimated cost of improving these is $3,000, the plant being furnished.

Very respectfully, your obedient servant,

F. A. HINMAN,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

REPORT OF MR. H. C. COLLINS, ASSISTANT ENGINEER.

NORFOLK, VA., *January* 20, 1885.

CAPTAIN: I have the honor to submit the following report on my survey of Cashie River, N. C., with map of same (in five sheets and two sheets of cross-sections), made in accordance with your instructions of the 13th ultimo.

The Cashie River drains Bertie County, the county seat of which (Windsor) is at the head of navigation. This county is a good farming section of North Carolina, and has a large amount of pine and other valuable timber.

The annual fluctuation of this river at Windsor is about 3 feet, though freshets have frequently caused a rise of one or two feet more.

Except in time of freshets, the current is down stream or up, in accordance with the surface of the water in Albemarle Sound, into which it flows, having so little supply of water that any change of level in the sound is at once felt at Windsor.

The distance by river from Windsor to the mouth of the Cashie River is 25 miles, and there is no place where there is less than 9 feet in the channel at low water. On the bar in the sound there is, at extreme low water, but 8 feet, with a very wide channel, and no dredging is necessary anywhere.

The distance from Windsor to the Roanoke light-house, by channel, is 27 miles, but by air-line it is 14¼ miles. The river runs through bottom lands, covered with a heavy growth of timber and cane, only occasionally touching the cultivated high lands. The water is clear.

There is no railroad communication whatever, except that reached by the river and Albemarle Sound. The larger part of the trade of Bertie County passes over the Cashie River. There is one daily line of steamers connecting with the Norfolk Southern Railroad at Edenton, by way of Plymouth, carrying the mail, and one with four round trips per week, connecting with the Seaboard and Roanoke Railroad at Franklin, on the Blackwater River. A steamer runs between Windsor and Norfolk direct, making round trips once a week. During the fishing season other steamers run daily over the river to transport fish. Three tug-boats are constantly employed by one firm in towing saw-logs from this river to Norfolk. One steam barge and two barges without steam are also engaged in transporting lumber to the same point. Several other firms employ chartered tugs to tow saw-logs and hewn timber to Norfolk. A number of schooners also find employment, running from Windsor to various ports on the sound and along the coast. I could not get a statement of the annual amount of business done on the river.

There are three warehouses at Windsor which forward freight; also several large stores and one very large steam shingle factory. At nearly every landing on the river is a warehouse. Exports consist of lumber, timber, shingles, naval stores, farm produce, and fish, and imports of general country supplies.

The survey began at the bridge at Windsor. There are three wharves here which jut into the river, so that at the wharves there is a width of but 90 feet. Elsewhere in front of the town it is from 100 to 120 feet wide. There is no navigation above the bridge, which is a fixed one. A large number of logs are floated down from above and stored along the river waiting sale. Many of these logs remain a long time in the water; some become water-soaked, and one end sinks. The log is then cut out of the raft, and becomes an obstruction in the river. All logs are marked, and no one can take them out except the owner. They are not of sufficient value to pay each owner of a few sunken logs to remove them, yet, were any one to take them out, the owners could claim all with their mark. Those brought into the river by the log-railways are at once sawed up when they float low in the water, or rafted and towed away before they have time to become water-soaked. A large part of the obstructions consist of these sunken logs, and unless there shall be some legislation to compel owners of logs to take care of all they put in the river there can be no permanent improvement of it. Some remedy is also needed to prevent the felling of trees into the river, leaving either the entire tree or the top to be obstructions. A fine will not reach the case, as nearly all of this injury is done by men who are pecuniarily irresponsible.

There are two wrecks in the river at Windsor, located on the map, both of which are very dangerous as the river is so narrow. They have several times been the cause of considerable damage to vessels. They can be blown up with dynamite and removed easily.

The bank of the river at Windsor is 14 feet above low water, and the bottom lands opposite are 2 feet above low water. The bottom lands are covered with a heavy growth of timber and cane, and are traversed by numerous shoal sloughs which carry off some water in freshets. The first three miles below Windsor has a general course south, but the river is very crooked and touches the highland at but three places, at each of which is a landing.

There are many trees in the river. Those seen are located on the map, but by far the larger portion is under water.

The bends are not sufficiently sharp to injure the navigation, but there are overhanging trees in almost a continuous line on both sides of the river all the way for the first 8 miles below Windsor. At landing places a few trees have been removed so steamers could reach the bank. In places these overhanging trees are so thick that the whole bank will have to be cleared for 50 feet back from the water. The river

has never, so far as I could learn, been cleared. Nearly all species of trees found here sink at once, so that the great number in the river cannot be missed from the bank.

Steamers running on this river are mostly propellers, and draw about 8 feet. They feel their way along, hitting logs frequently and keeping clear of overhanging trees as far as possible, but damage is often done and loss of time is very great, as it takes more than double the time to run over the upper 8 miles than would be needed were the river in fair navigable condition.

From the third to the eighth mile below Windsor the course is nearly east, with a very crooked channel, through bottom lands, touching the high land at six landing places. At the eighth mile is H. Johnson's steam saw-mill and log railway, which brings in logs from 13 miles back in the country. No slabs or saw-dust get into the river from this mill. Having four steam vessels and two others running constantly on the river, Mr. Johnson appears to feel sufficient interest in the navigation to take all possible care not to injure it.

Cross-sections which accompany the map show the condition at many places, and give a good general idea of the river, but do not show the present condition in respect to obstructions. A longitudinal line of characteristic soundings is shown on the map.

Five miles below Johnson's is Jay-Cox's saw-mill landing. The mill is a mile back from the river and a railway brings the lumber to the landing. There are four landing-places on these 5 miles. The course of the river is a little south of east, and, though very crooked, it is much wider than above Johnson's, being nowhere less than 240 feet wide and frequently more than 500 feet in width. There are many herring fisheries between Johnson's and the mouth of the river, which employ a large number of men from February to May.

From Jay-Cox's to Sans Souci, 16 miles from Windsor, the river is everywhere more than 300 feet wide and over 20 feet deep in the channel. There are overhanging trees as above, but from the greater width they do not interfere materially with navigation. A few snags were located here and many more are said to be in the way under water. There are four fisheries and landing places. Sans Souci is the landing-place for quite a large settlement to the northeast of the river. It has a store and post-office.

One and one-half miles below Sans Souci the river runs south, and here, at 17½ miles from Windsor, the "Thoroughfare" enters it from the Roanoke River. This is the route of the mail steamer between Plymouth, on the Roanoke, and Windsor. Other vessels go down the Cashie. The "Thoroughfare" is 2¼ miles long and everywhere more than 10 feet deep in the channel at lowest stages Its width is about 200 feet except where obstructed.

There are quite a number of overhanging trees that require removal, but the two serious obstructions are the wreck of the steamer Chieftain and the blockade. The Chieftain lies along the right bank one-half a mile below the Roanoke head of the "Thoroughfare." It has caused quite a number of accidents, and, at times of high water in the Roanoke, there is a very strong current through the "Thoroughfare" to the Cashie. It is then very difficult to keep off from this wreck, though its position is well known. At low water portions of the machinery are in sight above water. It was a large side-wheel boat, with walking-beam, and was sunk in 1865. The "blockade," in a bend 800 feet below the head of the "Thoroughfare," was made during the late war by driving three rows of piles across the river. These piles are about 10 feet apart, and the only opening is about 55 feet wide, near the right bank, where piles have been removed to make a passage. The others yet remain, and large quantities of drift logs have lodged against the upper side of them, and quite a large amount of work will be needed to remove enough of the piles and other obstructions to make a channel 100 feet wide, which is needed here on account of the bend. So far as commerce is concerned this is a very important part of the Cashie River, as the mail boat must go this way.

From the mouth of the "Thoroughfare" the Cashie runs in a very crooked course to the northeast for 7½ miles, where it enters the head of Albemarle Sound. There are a very few overhanging trees, which, from the great width of the river, are not serious obstructions. But few snags are above water; however, there is said to be quite a large number below water, which, of course, are not shown on the map. There are ten large fisheries.

About one-half mile above the mouth of the Cashie is a side channel called Coshoke Creek, up to Coshoke Landing, 1 mile from the Cashie. It has a warehouse and wharf, and is the only landing for quite a large settlement. Steamers make special trips here once a week. There is no current. The width is 75 feet at narrow places, and the depth more than 9 feet, except on the soft bar at the mouth, where it is 7 feet. The channel is very much obstructed by overhanging trees and by snags. The navigation would be very good were these removed.

The survey was continued out over the bar into the sound to buoy No. 1, one-half a mile below the Roanoke light-house. The distance over this bar, from the mouth of the river to the buoy, is 2 miles. The depth near the Roanoke Channel is 8 feet at extreme low water, which is the least depth on the bar. The width here is one-quarter

of a mile, and where the channel is narrowest, about half way out, it is 300 feet between eight-foot curves and 13 feet deep in the middle.

No stumps or snags were found in the channel outside the river mouth. It is nearly straight, and bordered on each side by shad-net stakes. It is only at extreme low water that there is so little as 8 feet on this bar, and when the wind blows from the east the water rises a foot or more. No dredging is needed on this bar as the channels through which all vessels must pass farther down the sound have but 8 to 9 feet depth of water.

The whole river can be divided into sections for purposes of improvement. The upper 8 miles needs removal of two wrecks, a very large number of trees, logs, &c., from the channel, and their being so placed on the banks that they can never get into the river again. A continuous line of trees on both banks must be cut and pulled back away from the river so that they cannot get into it.

From the nature of the work it is not possible to make specifications in such a way that it can be done by contract. The best way to accomplish it is by hired labor, with the aid of proper machinery.

Basing the estimate for the work on the cost of doing it on other streams where similar work has been done, and in consideration of the fact that the plant on some other work may be available for this I make the following estimate:

Upper 8 miles, at $1,500 for clearing and snagging	$12,000
Removing two wrecks at Windsor, at $400 each	800
Lower 17 miles of river to mouth, at $500 for clearing and snagging	8,500
	21,300
Twenty per cent. for office expenses, engineering, and contingencies	4,260
Total	25,560

ESTIMATE FOR THE THOROUGHFARE AND COSHOKE CREEK.

Removal of overhanging trees from Thoroughfare, 2¼ miles	$100
Removal of wreck of Chieftain	600
Removal of blockade, including snags above it	800
Coshoke, 1 mile, clearing and snagging	1,000
	2,500
Twenty per cent. for office expenses, engineering, and contingencies	500
Total	3,000

This cost would properly be added to the above.

A complete outfit suitable for such work, with all necessary tools, tackle, and machinery for hoister and outfit for quarter-boat, will cost about $4,000, which makes the total estimate $32,560.

There could be no permanent improvement, except in respect to overhanging trees, the three wrecks, and the blockade, unless there should be some efficient legislation to prevent the present practice of storing saw-logs and felling timber in navigable waters, and also of cutting out sinking logs from rafts and leaving them in the channel, or where they may get into it.

The two wrecks at Windsor are each from 70 to 80 feet long, and about 20 feet wide. The Chieftain is much larger, 120 feet by 25 feet, as near as soundings will show. None of them have any value; the sunken logs would be of some value when removed.

Very respectfully, your obedient servant,

H. C. COLLINS,
Assistant Engineer.

Capt. F. A. HINMAN,
Corps of Engineers.

APPENDIX M.

IMPROVEMENT OF CERTAIN RIVERS AND HARBORS OF NORTH CAROLINA AND SOUTH CAROLINA.

REPORT OF CAPTAIN WILLIAM H. BIXBY, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1885, *WITH OTHER DOCUMENTS RELATING TO THE WORKS.*

IMPROVEMENTS.

1. Contentnea Creek, North Carolina.
2. Trent River, North Carolina.
3. Neuse River, North Carolina.
4. Inland Navigation from New Berne to Beaufort Harbor, via Clubfoot, Harlowe, and Newport rivers, North Carolina.
5. Harbor at Beaufort, North Carolina.
6. New River, North Carolina.
7. Cape Fear River, above Wilmington, North Carolina.
8. Cape Fear River, below Wilmington, North Carolina.
9. Great Pedee River, South Carolina.
10. Waccamaw River, South Carolina.
11. Harbor at Georgetown, South Carolina.
12. Santee River, South Carolina.
13. Wateree River, South Carolina.

EXAMINATIONS AND SURVEYS.

14. Northeast Branch of Cape Fear River, North Carolina.
15. Bogue Sound, North Carolina, between New River, and Beaufort.
16. Congaree River, South Carolina.
17. Black River, North Carolina.
18. Entrance to Winyaw Bay, near Georgetown, South Carolina.

UNITED STATES ENGINEER OFFICE,
Wilmington, N. C., August 6, 1885.

GENERAL: I have the honor to transmit herewith annual reports for the fiscal year ending June 30, 1885, upon the works of river and harbor improvement then in my charge.

Very respectfully, your obedient servant,

WM. H. BIXBY,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

M 1.

IMPROVEMENT OF CONTENTNEA CREEK, NORTH CAROLINA.

The amount appropriated by the act 5th July, 1884, together with the funds then available, was too small for economical work; but improvement was so much needed that small immediate actual results were regarded as more valuable than larger, but delayed, possible ones.

Owing to its experimental nature, its variable features, and the difficulty of properly specifying it beforehand and inspecting it afterward, the work was allowably done by hired labor and the purchase of materials in open market.

The special work of the year was as follows:

The river from its mouth, 45 miles up to Snow Hill, was roughly cleared of the obstruction which either had never been removed or which has fallen in during the last two years. This work could only be done during the high-water season. Between the 17th February and 27th April, 928 logs and 705 stumps were removed from the river-bed; and 174 large trees were cut from its banks.

The mouth of the river, where special diking appeared necessary, was carefully mapped in the low-water season of last December. The further work of actual diking was necessarily postponed until the next low-water season (August, 1885).

All the above work has been well and vigorously carried forward under the immediate supervision of Assistant Engineer R. Ransom, whose full report is appended.

The navigation of this river is obstructed at points, as shown by the following extract from special report, dated January 17, 1885:

Between Stantonsburg, the head of present improvement, and Snow Hill, the head of present navigation, there are three county bridges without draws, but there has, as yet, been no navigation demanding draws. When needed, the draws will undoubtedly be put in by the county authorities. I therefore recommend that these bridges be permitted, for the present, to remain in their present condition; provided that their owners will insert suitable draws therein whenever needed by steamers.

Recommendations for future work are as follows: That this improvement be completed in accordance with the present proposed and approved project, so as to secure a thoroughly cleared 3-foot navigation over the entire river from its mouth, 75 miles upward, to Stantonsburg, during the nine commercial busy months of the year, at a total expense of $50,000, in addition to the $1,731.39 now available, this amount to be appropriated in two yearly installments of $30,000 and $20,000, respectively. Further improvement, so as to extend this navigation above Stantonsburg, or so as to make the lower river navigable during the low-water season, is not recommended at present.

This river is in the second collection district of North Carolina.

Money statement.

Amount appropriated by act approved July 5, 1884		$5,000 00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$3,009 28	
July 1, 1885, outstanding liabilities	259 33	
		3,268 61
July 1, 1885, amount available		1,731 39
Amount (estimated) required for completion of existing project		51,731 39
Amount that can be profitably expended in fiscal year ending June 30, 1887		30,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

REPORTS OF MR. R. RANSOM, ASSISTANT ENGINEER.

1.

UNITED STATES ENGINEER OFFICE,
Wilmington, N. C., June 30, 1885.

CAPTAIN: I have the honor to submit the following report of operations upon Contentnea Creek for the year ending June 30, 1885.

Nothing was attempted upon this stream until December 1, 1884, when by your orders a surveying party under Mr. John P. Darling, assistant engineer, was directed to make a survey near the mouth of the stream.

It progressed until December 11, when high water stopped further work. The reports and maps of Mr. Darling are in your possession and contain all pertinent information.

There being no plant for that stream, that from the Neuse was transferred to it from the Trent February 9, 1885, and towed a short distance, but the only steamer that could be engaged for this work being unable to stem the current, the plant had to be "warped" up. As you directed, work was begun at Snow Hill on the 17th February, and progressed down-stream, going over what had been done previously. That part of the creek or river between Snow Hill and Hookerton had been worked at a very high stage of water, and the same unfortunate obstacle to satisfactory operations was encountered the past winter. But during the two months and ten days employed upon it, 928 logs and 705 stumps were removed, and 174 large trees cut from the banks; a considerable amount of lighter work was accomplished. Almost all done on this stream was between Snow Hill and Hookerton; a few trees and stumps were taken out lower down.

The work heretofore done has consisted of removing obstructions from the channel from its mouth to Snow Hill and in clearing the banks of overhanging growth. Up to Hookerton that kind of work may be considered complete, except as to what may hereafter be required from erosion and other natural causes. Above Hookerton some more work will be needed, and it should be done at low water. Near the mouth, as indicated on the recent maps of Mr. Darling, there have been built heretofore about 800 feet of frame dikes, thus: Lumber piles of heart pine 6 inches by 6 inches were sunk 5 feet apart; the tops of these piles are about 3.5 feet above low water. Stringers or wales were fastened by one-half inch wrought-iron spikes and to these pieces were nailed with forty-penny nails sheet-piling sunken into the earth, and the tops sawed flush with the tops of the wales. This diking was placed across low places to confine the water to the channel. The wales were 4 by 6 inches and 20 feet long, each piece.

In my former reports I have described this portion of Contentnea Creek. The survey of Mr. Darling establishes the fact that a ridge runs between this and the Neuse several feet above high water, to within a short distance of the mouth, and a recent inspection has discovered that the water escaping from the Contentnia at high stages over its banks below Jolly Old Field, finds its way to the head of Grindle Creek, about 600 or 800 yards below, and Grindle Creek flows into the Neuse River some 2.5 or 3 miles from the mouth of the Contentnea.

The directions you first gave for the further improvement of this lower part of Contentnia Creek have not been complied with because of your instructions subsequently received.

I have no hesitation in repeating the recommendations I have heretofore made regarding this stream, believing that the benefits to be derived will justify the outlay.

Below is a statement of the commerce of this small river. It is necessarily incomplete and does not give a just idea of the capabilities and actual products of the region it drains. Last fall was very dry and it was nearly the end of 1884 before boats could run upon the Contentnea.

	Value.
Outward:	
6,000 bales of cotton	$270,000
11,000 bushels of rice	11,000
Inward:	
About 2,800 tons of general merchandise	140,000
Total	421,000

There are considerable quantities of lumber, shingles, and various articles impossible to ascertain which furnish, with the above, freights from two to four steamers during the carrying season. All the above items and many others will greatly increase with better and more certain facilities for reaching markets promptly.

Very respectfully, your obedient servant,

R. RANSOM,
Assistant Engineer.

Capt. W. H. BIXBY,
Corps of Engineers.

P. S.—On the 26th March, one of the hoisters was partially burnt by accident, which has been repaired at a cost of about $200 (for boiler and engine $115, lumber $45, labor $55 or $60).

R. RANSOM.

2.

UNITED STATES ENGINEER OFFCE,
New Berne, N. C., July 11, 1885.

CAPTAIN: I have the honor to supplement my annual report for the past year for Contentnea Creek by submitting the following estimate to complete the present project:

ENGINEERING PROPER.

Clearing the stream from Snow Hill to Stantonsburg of logs, stumps, brush, &c., and cutting away overhanging growth, about 35 miles which has not been touched	$25,000
Going over stream from Snow Hill to mouth in same way	2,000
Clearing way and building dams near mouth and diking	5,000
General and local inspection	3,200
Contingencies	3,520
Total	38,720

To this should be added an annual appropriation of $3,000 to keep the river open, as the works cannot be made permanent.

Very respectfully, your obedient servant,

R. RANSOM,
Assistant Engineer.

Capt. W. H. BIXBY,
Corps of Engineers.

M 2.

IMPROVEMENT OF TRENT RIVER, NORTH CAROLINA.

Owing to its experimental nature, its variable features, and the difficulty of properly specifying it beforehand and inspecting it afterwards, the work was allowably done by hired labor and the purchase of materials in open market.

The special work of the year was as follows:

Between December, 1884, and April, 1885, the already-commenced turning basin at Trenton was thoroughly completed by the construction of a solid wharf revetment wall, and by the redredging of the basin to 6 feet depth at low water; this depth of dredging being necessary to allow for future deposits coming from further up-stream. At the same time the whole river from its mouth all the way up to Trenton was cleared of its sunken and overhanging obstructions, and 565 logs and 52 stumps were thus removed from its bed.

In February and March, 1885, careful surveys were made of all the points on the river where dredging was supposed necessary.

Between 3d April, 1885, and 20th June, 1885, the river from the turning-basin 4,300 feet down-stream to a permanent 3-foot channel was thoroughly dredged to at least 4 feet depth and 75 feet width at low water, and 11,825 cubic yards of material were removed from its bed.

In May and June, 1885, a channel, 5 feet deep at low water, 100 feet wide, and 2,000 feet long, was cleared through the obstructions at Foy's

Flats, preparatory to its being deepened later to 6 or 8 feet, and 145 stumps and 65 logs were removed therefrom.

All the above work has been well and vigorously carried forward under the immediate supervision of Assistant Engineer R. Ransom, whose full report is appended.

Recommendations for future work are as follows: That the present approved and adopted project be completed by thoroughly clearing the present channel of its remaining obstructions, at a total cost of $15,000 (in addition to the $670.44 now available), this amount to be appropriated in one sum within the next year. After this is done no further improvement is recommended at present.

This river is in the collection district of Pamplico, N. C.

Money statement.

Amount appropriated by act approved July 5, 1884		$10,000 00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$6,217 65	
July 1, 1885, outstanding liabilities	3,111 91	
		9,329 56
July 1, 1885, amount available		670 44
Amount (estimated) required for completion of existing project		10,670 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		10,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1886 and 1867.

REPORT OF MR. R. RANSOM, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
New Berne, N. C., July 17, 1885.

CAPTAIN: I have the honor to submit the following report of operations for the improvement of Trent River, North Carolina, for the year ending June 30, 1885.

There being no plant belonging to this stream, that from the Neuse was used for the prosecution of the work, together with a hired dredge.

Early in December one of the hoisters was sent to Trenton to revet in a more substantial manner the turning basin at that point. For this purpose, on the south side the following-described structure was built in general accord with your detailed directions; at an angle to each other of about 115° two lines of cypress piles, a foot or more in diameter at the small end, 5 feet apart, were sunk as far as they would bear driving. To these piles were bolted, with five-eighths-inch rod iron, stringers 6 inches by 10 inches 1 foot below lowest water, and 7 feet above this line of stringers one just similar was likewise fastened. To these stringers, top and bottom, were nailed 3-inch thick sheet-piling, with 60-penny cut nails, after it had been sunk to "hard pan" by a water jet from a strong steam-pump. Outside of this sheet-piling was placed another row of cypress piles with stringers similar to the other and against the sheet-piling, the piles and stringers being opposite to those first put in. These two rows of piles were bound together by five-eighths inch rod iron through each set of piles, two and two, and longer rods of three-fourths-inch rod iron tied the sets of piles to another line of piles which had been put in the year before in an imperfect and rude structure. The whole was made flush on top with the upper stringers. The lumber used was the best heart long-leafed pine. Coffer-dams had to be resorted to to put in this revetment.

During the time that one hoister was at Trenton the other was used to remove obstructions from the channel from Quaker Bridge to Trenton, and a party with it cut from the banks overhanging growth.

In February and March, by your direction, Mr. J. P. Darling, Assistant Engineer, made a close survey of parts of this river, over Foy's Flats, about 5 miles above New Berne, for the purpose of determining the best route for a dredged channel through that difficult part of the river, and from 500 feet above Trenton to 500 feet below the mouth of the mill-race near that place. This last survey was made f r the purpose of fixing the location, and to determine the amount of dredging required to get a

suitable channel where so much filling had taken place during the year previous. This, with the survey of the points at as many bends in the river below, constituted the surveying done upon the Trent.

On April 3, 1885, a dipper dredge, under contract by you, was put to work upon that portion of the river just at and below Trenton, to secure a channel over that part just surveyed, of 4 feet depth and 45 feet mean width. This was completed as far as possible by the 20th of June, when, for want of funds, the work was stopped. For the last thirty days of this dredging it was under the personal direction of Inspector Frement and Overseer Kinsey, as I was too unwell to give it the usual supervision.

The dredge excavated 11,825 cubic yards of sand and marl. About half of this material had to be moved up steep banks by shovels and barrows; wherever possible, and over about half of the distance dredged, this extra labor was avoided by the use of rough log revetment to retain the excavated material. This was constructed in general accord with your directions, and is of horizontal logs tied back into the bank by cross-logs and staked in front. It is from two to four logs high, which are from 6 to 18 inches in diameter. About 4,000 or 5,000 cubic yards of sand were moved from 50 to 300 feet in grading near the basin.

From the main channel between Trenton and Quaker Bridge 565 logs and 52 stumps were removed during the season.

At Foy's Flats, in May and June, out of the now 100-foot wide channel 65 logs and 146 stumps were removed. The stumps had to be blasted out, which was done with giant powder and electric battery. There are probably many more stumps lying or standing just even with or below the surface of the present bottom.

It is to be regretted that the appropriation was not sufficient to have cleared this Foy Flat channel with a dredge, particularly as one was employed just before stopping work upon another part of the river.

To complete this improvement under existing project the following estimate is submitted, and I respectfully recommend that the whole appropriation be made at one time on the score of expediency and economy.

The propriety of the improvement has long since passed the point of conjecture:

Dredging at Foy's Flats, 5,500 cubic yards, at 30 cents per yard	$1,650
Taking out 100 stumps, at $20 each	2,000
Dredging of ten points (see map), 14,000 cubic yards and grubbing, at 40 cents per pard	5,600
Taking out 100, logs at $5 each	500
Taking out 50 stumps, at $5 each	250
Cutting from banks 100 large trees, at $3 each	300
General supervision	1,000
Local supervision	1,500
Contingencies	1,280
Total	14,080

Add to this an annual outlay of $3,000 for keeping up the improvements, as it is hardly practicable to make them entirely permanent.

Below is an approximate estimate for the commerce on this stream, gathered with the kind and efficient aid of Assistant Engineer Reid Whitford, who rendered this service and relieved me when such assistance was most timely.

Outward:

5,500 bales of cotton	$247,500
1,000,000 feet lumber	10,000
6,000 barrel potatoes	18,000
140,000 bushel cotton seed	14,000
15,000 packages truck	30,000

Inward: About 2,500 tons general merchandise, such as fertilizers, hay, salt, lime, flour, farm implements, &c., valued at $125,000, making nearly $500,000.

No account could be gotten of what was carried both ways by hand-craft.

Upon inquiry I learn that the estimate of Mr. C. E. Foy for 1882, embodied in my report of that year, excepting the bricks, is very much nearer the real amount shipped on the Trent the past year than that above given; but values are not so high this year. From the most trustworthy authority that I can obtain the shipments over the Trent River have doubled in the past five years. Last year was not a favorable one, and this year prices have not paid for the shipping of much of the truck, and it has laid at home.

Very respectfully, your obedient servant,

R. RANSOM,
Assistant Engineer.

Capt. W. H. BIXBY,
Corps of Engineers.

M 3.

IMPROVEMENT OF NEUSE RIVER, NORTH CAROLINA.

Owing to its experimental nature, its variable features, and the difficulty of properly specifying it beforehand and inspecting it afterwards, the work was allowably done by hired labor and the purchase of materials in open market.

The special work of the year was as follows:

Between the 1st July and the middle of December, 1884, the river was thoroughly contracted by jetties over a total distance of about 5 miles, situated from 40 to 45 miles above New Berne, and from 5 to 10 miles below Kinston. This work could be done advantageously only during the high-water season.

One hundred and twenty-one jetties (12,402 linear feet of jettying) were thus built in place; and 164 sunken logs, 50 stumps, and several cords of small snags were removed from the bed of the river.

Maps were made of about 10 miles of the river so far jettied, so that the results of this work can be determined and utilized in future similar work.

Two new quarter-boats and four new flats were built ready for the next season's work.

All the above work has been well and vigorously carried forward under the immediate supervision of Assistant Engineer R. Ransom, whose full report is appended.

The completion of a thoroughly cleared 4-foot channel from New Berne to Kinston will require still the jettying of about 3.5 miles more of river, and the removal of a great many snags, logs, and trees from the bed of the river.

This work will be pushed forward rapidly during the coming high-water season, and carried as far as the present funds will permit.

The navigation of this river is obstructed at points as shown by the following extract from special report dated 17th January, 1885:

> Near Kinston this river is crossed by the Atlantic and North Carolina Railroad, on a draw-bridge, whose draw-span is placed upon the shallow side of the river instead of over the main channel-way.
>
> The present improvement will probably be so far finished in 1886 as to permit of a deeper navigation above this bridge at Kinston than will then be able to pass through this draw-opening.
>
> All the steamer captains whom I have so far heard from state that they have not as yet been delayed from want of water at this draw-opening; and I do not see any reason for a change in position of the draw before 1886.
>
> I therefore recommend that this draw may be permitted to remain in its present position for the present; but that it be moved to the channel side of the river as soon as it becomes the chief serious obstruction to a permanently increased depth of navigation between New Berne and Kinston.
>
> Near Goldsborough this river is crossed by the Wilmington and Weldon Railroad, on a single-span bridge without a draw. The bottom of the bridge is about 17 feet above low water. The channel is said to be partially obstructed by a pier of the former bridge. Very few steamers have so far reached this bridge, although the river is navigable for several miles above Goldsboro'.
>
> I therefore recommend that this bridge be permitted for the present to remain in its present condition, provided that the owners will clear away the obstructing portion of the old pier beneath; and provided, also, that they will furnish a suitable hinge joint to the smoke-stacks of all steamers using regularly this portion of the river.
>
> Above Goldsboro' and below Smithfield there are six county bridges without draws; but there has as yet been no navigation demanding draws. When needed, the draws will undoubtedly be put in by the county authorities. I therefore recommend that these bridges be permitted, for the present, to remain in their present condition, provided that their owners will insert draws therein whenever needed by the steamers.

Recommendations for future work are as follows : That this improvement be completed in accordance with the present approved and adopted projects, so as to secure a thoroughly cleared 9-foot navigation 16 miles up to New Berne; and a similar 4-foot navigation 50 miles further to Kingston during the entire year, and thence a similar 3-foot navigation 108 miles further to Smithfield during nine months of the year; at a total expense of $160,000 (including the funds $13,731.70 now on hand), this amount to be appropriated in three yearly installments of about $60,000 each. Further improvement, so as to extend the navigation above Smithfield, or so as to increase the depth of water or length of time of such navigation below Smithfield, is not recommended.

This river is in the collection district of Pamplico, N. C.

Money statement.

July 1, 1884, amount available		$5,862 97
Amount appropriated by act approved July 5, 1884		20,000 00
		25,862 97
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$11,893 11	
July 1, 1885, outstanding liabilities	238 16	
		12,131 27
July 1, 1885, amount available		13,731,70
Amount (estimated) required for completion of existing project		160,000 00
Amount that can be profitably expended in fiscal year ending July 30, 1887		60,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for furnishing lumber, iron, and nails, for improving Neuse River, North Carolina, opened at 12 m., May 1, 1885.

No.	Names and addresses of bidders.	Price.	Remarks.
	B. W. Canady, Kinston, N. C.....	$14 per M for lumber, 2¾ cents per pound for iron, $3 per keg for nails.	Proposal to furnish all.
	H. C. Parrott, Kinston, N. C.....	$13 75 per M for whole, $14.50 per M for half, $15 per M for one-fourth.	Proposal to furnish lumber only.
3	Nathan O. Berry, Goldsborough, N. C.	$15 per M for lumber	Do.
4	Burr & Bailey, Wilmington, N. C.	4 cents per pound for iron, $3.79 per keg for nails.	Proposal to furnish iron and nails only.

Contract with B. W. Canady.

REPORT OF MR. R. RANSOM, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
New Berne, N. C., June 30, 1885.

CAPTAIN: I have the honor to submit the following report of operations for Neuse River, North Carolina:

The work has consisted almost exclusively of building jetties, of which 121 in number were put in, aggregating 12,402 linear feet.

The work on the 1st July, 188-, was near the Old Blockade, about 5 miles below Kinston, and was continued down-stream to within about a mile of Becton's Old Field.

As a general thing the jetties are 250 feet apart up and down the stream, and their position as to the bank from which they run is determined by the contour of the stream. About the same distance is preserved between the jetties in crossing from bank to bank, and an open space from channel end of jetties to opposite bank of about

120 feet is likewise preserved. It is proper here to state that a narrowing of this space to 90 or 100 feet might be desirable.

The construction is simple and economical. A single row of heart pine lumber piles is driven perpendicular to the current, being first sunken by a "water jet" from a good steam-pump, and then hammered with a pile-driver. The piles are sawed off 3 feet above low water, and to their upper sides, flush with the tops, a single stringer is fastened by half-inch rod iron spikes.

The channel end of each jetty as lastly built has a very short offset of 5 feet downstream at right angles to the jetty. This offset is made only long enough to give the necessary stiffness against overturning to the end of the jetty, and to give a proper support to its mattresses. The five or six piles next to the channel end are 8 by 8 inches, the others 8 by 6 inches, and the sheet-piles 8 by 2 inches, varying in length according to necessity. The sheet-piles are sunk by the water jet, and the past season were carried up the slope of the bank by direction of your immediate predecessor, and are fastened to the wale or stringer by forty-penny cut nails, and sawed off flush with the top of the wale. The channel ends of the jetties are protected under water against scour by mats of small logs in half-cross form, covered with brush and sunk by rock, marl, or clay, as may be the most convenient.

The sheeting carried up the bank acts badly, and it is proposed to abandon that method and only run well back into the bank upon a level.

About 500 linear feet of jettying put in the past season has washed out. The freshets have so recently subsided that the cause for that injury has not yet been ascertained.

A very recent inspection of the river shows that below the mouth of Contentnea Creek about 2,000 linear feet of jetties have been greatly injured and much of it taken away by rafts of timber passing over just before the water fell above the tops of the jetties. This will need replacing and repairs.

There are at intervals between Becton's Old Field and New Berne, or, more properly speaking, from Becton's Old Field to Spring Garden, 14 miles above New Berne, spaces where jetties should be placed aggregating about 13,000 feet. That would require some fifty jetties, or about 5,000 linear feet. In estimating this work I have been governed by the past.

During the year two new quarter-boats and four new flats were built.

The hoisters were built six years ago, of green timber, and were repaired two years ago. I hardly think they can be relied upon for another year. The machinery continues as good as could be expected after the hard wear it has had.

With what remains of the present appropriation it is proposed to continue jettying, so as to connect the system as far down as possible.

To complete the work now immediately in hand, which has for its object to secure a channel of 3 feet depth at all seasons from New Berne to Kinston, I respectfully submit the following estimate:

For strictly engineering work:	
Constructing 7,500 feet of jetties (which includes rebuilding and repairs)	$10,000
Surveys	2,000
Taking out 300 logs, at $5 each	1,500
Taking out 100 stumps, at $5 each	500
Cutting from banks 200 trees, at $3 each	600
General supervision	1,000
Local supervision	1,500
Add 10 per cent. for contingencies	1,510
For general work annually from New Berne to Smithfield	7,500
Total	26,110

Below is a statistical table of the commerce of this river, as correct as I have been able to secure, even with the effective aid of Mr. Reid Whitford, assistant engineer, to whom I express warm thanks for valuable assistance in collecting the data.

	Value.
Outward:	
16,000 bales of cotton	$720,000
10,000 bushels rice	10,000
350 barrels spirits turpentine	7,000
4,000 barrels rosin	8,000
200,000 feet timber	2,000
757,750 shingles	38,000
Total	785,000
Inward:	
About 5,200 tons of freight, such as hay, salt, iron, fertilizers, flour, &c.	260,000
Grand total	1,045,000

The trucking and fishing from this stream will be included in the general report of the commerce of this city, as represented in the report of the Board of Trade, which report I herewith inclose without remark, as it is clear and pointed. Appended to this is the report of the collector of customs of this place, which needs no explanation.

In the beginning of the improvements, after the greater obstructions were removed, tentative efforts were made and all was done that could be under the circumstances, to aid the transporters to get produce forward and merchandise in, and while some irregularity in system is admitted, the demands and necessities of commerce justified the course.

The amount estimated is as little as the work required can be done for. I earnestly recommend that it be appropriated.

Very respectfully, your obedient servant,

R. RANSOM,
Assistant Engineer.

Capt. W. H. BIXBY,
Corps of Engineers.

COMMERCIAL STATISTICS.

NEW BERNE, N. C., *June* 30, 1885.

DEAR SIR: Replying to your favor of 22d June, in which you request the Board of Trade of this city to furnish you the commercial statistics for the year ending June 30, 1885, below please find statement of what has been received and shipped:

Articles.	Quantity.	Value.
OUTWARD FREIGHTS.		
Cotton ..... bales..	53, 601	$2, 412, 045
Rice ..... bushels..	100, 000	100, 000
Corn ..... do	315, 000	189, 000
Spirits turpentine ..... barrels	1, 100	22, 000
Rosin ..... do	5, 634	11, 268
Pitch ..... do	2, 101	4, 202
Tar ..... do	926	1, 852
Lumber ..... feet..	8, 000, 000	80, 000
Shingles	2, 277, 750	6, 822
Canned goods ..... cases..	34, 711	52, 066
Wooden plates ..... packages..	7, 966	5, 975
Wooden dishes ..... do ...	1, 827	1, 827
Truck ..... do ..	150, 000	300, 000
Melons ..... do	261, 157	26, 115
Clean rice ..... tierces..	80	1, 600
Cotton-seed oil ..... barrels..	1, 000	15, 000
Cotton-seed meal ..... tons..	300	6, 000
Cotton-seed ..... do ...	1, 200	5, 000
Beeswax ..... casks..	40	1, 600
Honey ..... barrels..	60	1, 800
Peanuts ..... bags..	2, 000	3, 000
Hides ..... packages..	500	8, 500
Wool ..... bags..	70	350
Rags ..... packages..	600	1, 200
Sweet potatoes ..... barrels..	3, 000	4, 500
Fish-oil ..... do ...	250	4, 000
Eggs ..... packages..	922	5, 532
Miscellaneous ..... do ...	2, 512	12, 560
Expressage, including fresh fish, game, &c ..... tons..	720	144, 000
Total	.....	3, 427, 814
INWARD FREIGHTS.		
General merchandise, such as hay, salt, fertilizers, dry goods, groceries, lime, &c.. estimated value ..... tons..	20, 000	1, 000, 000

The foregoing statements are collected from the regular transportation lines only. There are freights carried both ways by numerous small sailing craft, pole-flats, &c., of which no account is kept, and from which it is impossible to gather any correct amount. I should say, however, that the total values of exports and imports would not be less in round numbers than $4,500,000.

The commerce is carried on by regular lines of first-class steamers between this

place, Norfolk, Baltimore, and cities further north, by railroad to interior of the State, and to the coast by steamers running regularly on the rivers watering this section, by sailing vessels to the West Indies and coastwise, and also by smaller sailing craft, pole-flats, &c.

There exists in the city manufactories of woodenware (plates and dishes, &c.), paper-pulp, bricks and tiles, cotton-seed oil and cotton-seed meal, corn meal, clean rice, cotton yarns, naval stores, straw brooms, shingles, lumber, ironware, canned goods, and marble ornaments. Upon the whole the commerce has gradually increased in the past ten years. During that time the trucking industry has grown into one of importance, as will be seen by a glance at that item in the foregoing list. Ten years ago not a package of truck was shipped from here. The beneficial influence over trade of the various works of improvement conducted by the United States Government in this vicinity is too evident to require any explanation. Suffice it to say, however, that five years ago two small steamers did the business on the rivers, where now ten larger ones are required for that purpose.

The progress of these works under your successful management has been watched with growing interest, and it is earnestly hoped and desired that you may be able to continue them uninterruptedly till completed.

Very respectfully, yours,

GEO. B. GUION,
Chairman of the Committee on Statistics and Information
Of Board of Trade, New Berne, N. C.

Approved:

K. R. JONES,
President.
JAMES REDMOND,
Secretary and Treasurer.

General ROBERT RANSOM,
Assistant Engineer.

LETTER OF COLLECTOR OF CUSTOMS AT NEW BERNE, NORTH CAROLINA.

CUSTOM-HOUSE, NEW BERNE, N. C.,
Collector's Office, June 23, 1885.

SIR: In compliance with your request, I herewith present the commercial statistics of this collection district for the fiscal year ending June 30, 1885, namely:

Number of vessels entered from foreign ports, 5	tons..	554
Number of vessels cleared for foreign ports, 4	do...	394
Number of vessels entered coastwise, 302	do...	122.750
Total value of dutiable imports		$2,799 92
Total amount of duty collected		1,728 78
Total value of free goods		2,606 96
Total value of domestic exports		6,064 50

NUMBER AND TONNAGE OF VESSELS DOCUMENTED AT THIS PORT.

Sail vessels:	
Register	1
Tonnage	80.28
Enrolled	19
Tonnage	951.20
Licensed	39
Tonnage	2,294.31
Steam vessels:	
Enrolled	13
Tonnage	743.36
Sail and steam license under twenty tons	85
Tonnage	1,000.00

I am, very respectfully,

T. A. HENRY,
Collector.

General ROBERT RANSOM,
New Berne, N. C.

M 4.

IMPROVEMENT OF THE LINE OF INLAND NAVIGATION FROM NEW BERNE TO BEAUFORT HARBOR, NORTH CAROLINA, VIA CLUBFOOT, HARLOWE, AND NEWPORT RIVERS.

The amount appropriated by the act of August 2, 1882, was too small for economical work, but improvement was so much needed that small immediate actual results were regarded as more valuable than larger but delayed possible ones.

Owing to its experimental nature, its variable features, and the difficulty of properly specifying it beforehand and inspecting it afterwards, the work would have been better done by hired labor and the purchase of materials in open market. Work was, however, required to be done as far as possible by contract, in accordance with the following abstract of proposals:

Abstract of proposals for furnishing one or more dredges for use in Clubfoot and Harlowe creeks, inland line of navigation from New Berne to Beaufort, opened at 12 *m., June* 30, 1884.

No.	Names and addresses of bidders.	Kind of dredge.	Capacity of dredge, cubic yards.	Rate per hour.	Date dredge will be available for work.
1	George E. Ward, Washington, D. C.	One Osgood improved boom-dipper.	50 per hour	$59.80 per day, or $5.98 per hour.	Oct. 1, 1884.
2	Thomas P. Morgan, Washington, D. C.	One clam-shell (small pattern) and one dipper.	Clam-shell, 70 per hour; Dipper, 50 per hour.	$4.98 each.....	On or before Oct. 1, 1884.
3	Daniel Constantine, Baltimore, Md.	One dipper.....	50 per hour	$6 per hour	Not stated.
4	James Caler & Son, Norfolk, Va.	One dipper.....	50 per hour	$6.50 in Harlowe River; $7 in Clubfoot River.	On or before Oct. 1, 1884.

The contract was awarded to Mr. Thomas P. Morgan. His work was commenced October 29, 1884, and stopped unfinished March 12, 1885; 1,500 cubic feet in all was dredged.

The special work of the year was as follows:

After the contracts had been awarded, the creek was surveyed and the line of proposed canal located thereon.

The contractor's first dredge (dipper) arrived on October 29, 1884, and the second (grapple) dredge on December 19, 1884. The banks of the creek were too soft to hold up the deposited material as deposited by the contractor's dredges, and he found it impossible to do the work in accordance with the specifications.

The grapple-dredge left on February 6, 1885, and the dipper dredge on March 12, 1885, having excavated 1,500 cubic yards of material.

The creek was carefully resurveyed and its surroundings examined with special reference to future work.

All the above work has been well and vigorously carried on under the immediate supervision of Assistant Engineer R. Ransom, whose full report is appended.

Owing to various mitigating circumstances, Mr. Morgan's contract was recommended for annulment without forfeiture. The letter of rec-

ommendation, dated May 21, 1885, with its indorsements, explains fully the present situation, and is as follows:

UNITED STATES ENGINEER OFFICE,
Wilmington, N. C., May 21, 1885.

SIR: I have to recommend the annulment (but without forfeiture of retained pay) of the present contract, dated July 11, 1884, with Thomas P. Morgan, for dredging at Harlowe Creek, inland line of navigation from New Berne to Beaufort Harbor, N. C., and to recommend that the work be readvertised under new specifications, the present contractor never having made the daily progress guaranteed by his contract; the non-forfeiture of retained pay being recommended because of my opinion that the contractor's dredges, though accepted, were not suited to the work, and could not be expected to do it ever as originally specified.

The funds now available are $8,000, and $10,000 more are needed to complete the reduced project now in immediate consideration. * * *

An examination of the back records of this work shows that my predecessors did not wish at first to commence work at all with the present small funds (see letter of Capt. James Mercur, of March 20, 1884, to your office), and having to commence, they wished to hire the work by the hour and not by the yard, on the plea that the latter was impracticable (see letters of Captain Mercur, as above quoted, and also of Capt. F. A. Hinman, of April 23, 1884, both to your office.)

The present project for the improvement of the line of inland navigation from New Berne to Beaufort Harbor, N. C., comprises dredging throughout the whole length of Harlowe River, over a distance of about 17,500 linear feet.

In the lower third (for about 4,900 feet length) there is an average breadth of 200 feet of soft mud, without any marsh at all, on both sides of the proposed channel. This mud varies in depth from 6 to 18 feet, is bare at low water, and is only covered by about 2.5 feet at the highest water. Obviously no ordinary dipper or ordinary clam-shell dredge can here carry out the requirements of the present specifications as regards dumpage.

In the upper two-thirds (for about 12,600 feet in length) of Harlowe Creek, the part to which the present small appropriation should first be applied, the cutting must be made at an average distance of about 200 feet from solid ground. The intervening material is a thin marsh sod, from 12 to 18 inches thick, underlaid with soft black mud of the consistency of butter. The marsh sod and mud have now been carefully examined and sounded throughout the entire length of the creek along the line of the desired cutting. At the upper end of this cutting the mud is about 4.5 feet deep, at the middle about 9.5 feet deep, and near the lower end about 10.5 feet deep. No ordinary dipper-dredge or ordinary clam-shell dredge can carry out the requirements of the present specifications as regards dumpage. The dredged material, being soft mud, would have to be deposited, on an average, at least 40 feet from the cut, and even then the marsh sod does not afford a solid foundation for this dumpage.

When the excavated material has been deposited, according to the specifications, by a clam-shell dredge having a 27-foot clear overhang of boom, the marsh sod has proved too weak to hold up the superincumbent embanked mass. A thin board flooring, 40 feet wide, made of inch plank, doubled and crossed, proved insufficent to prevent the sod from yielding and the banks from caving. This flooring cost (labor included) about 18 cents per square yard, or about 81 cents per linear foot. A log flooring, 40 feet wide, made of straight logs of 8 inches diameter and 40 feet length, laid perpendicular to the line of cutting, prevented the sod from yielding and the banks from caving. This flooring cost (labor included) about 18 cents per square yard, or 81 cents per linear foot. If adopted, it would have to be used upon at least one side of the entire cutting over a length of 12,600 feet, and would therefore cost about $10,200, or more than the present appropriation.

The very least amount of dredging advisabie in this section of Harlowe Creek will average about 6.7 cubic yards per linear foot of cutting, costing at the present contract price ($0.0996 per cubic yard) about 67 cents per linear foot; in all, about $8,440, or about 84 per cent. of the present appropriation.

In order that the marsh sod should alone with certainty uphold the embankment of dredged material to be deposited only on one side of the cut (as required by direction of the office of the Chief of Engineers), this material should, in my opinion, as based on the present experience, be deposited well back from the edge of the cutting, about 40 feet at the upper end of the marsh where the mud is 4.5 feet deep, at least 60 feet at the middle where the mud is 9.5 feet deep, at least 80 feet at the lower end of the marsh where the mud is 10.5 feet deep, and at least 120 feet at the lower end of the river where there is nothing but soft mud.

However, if the dumpage is deposited at a distance not less than 40 feet from the edge of the cut; if no retaining-wall be allowed anywhere to prevent the dumpage from assuming its natural slope; if the maximum height of the dumpage be restricted

to 3 feet above the material surface of the marsh; if this dumpage be allowed on both banks of the cutting, and if all the dumpage then running back into the cutting be redredged and replaced (which I think should be done at the contractor's expense)—under these circumstances I believe that the marsh sod should generally hold up the dumpage, that the banks which might cave in would be few and short, so that the caves could be redredged, which I think should then be done at the expense of the United States, and that the upper two-thirds of the proposed cutting could be opened in fair shape by means of the funds still in hand for the purpose.

I do not think, however, that any ordinary dipper and clam-shell dredge can do this work; neither do I think that any dipper and clam-shell dredge should be expected to do such a small amount of dredging over such a long extent of cutting for 10 cents a cubic yard.

The dredging is of itself of the easiest description, being a soft, buttery mud, and suitable depositing machinery is all that is needed to secure good results at a moderate cost. The work can be readily done by a suction-dredge, or by a rotary endless bucket-dredge with a long chute.

Considering the acceptance of the present contractor's bid to do the work with a dipper and clam-shell dredge, considering also that he had a right, from the reading of the present specifications, to expect a solid bank on which to deposit the dumpage, I do not think he should be held to forfeit the 10 per cent. of the retained pay, nor to be considered as a failing contractor. I think that 4 cents a cubic yard is a fair allowance for the extra work of transportation of the dumpage to a clear distance of at least 40 feet from the edge of the cut, partly required by the non-existence of a solid bank strong enough to hold the dumpage.

My letter of January 16 to your office, with its indorsement of the supervising engineer of the 17th, is, in general, in favor of allowing dumpage on both sides of the cutting, of allowing a small dumpage retaining-wall to be built at the contractor's expense, of allowing some extra payment for the removal of logs and stumps, and of extra payments for redredging caving banks. To this I now add the above-mentioned allowance of 4 cents per cubic yard for extra transport of the dredged material.

In the endeavor to arrive at some modifications of the present contract, I proposed last month to the present contractor that he should ask to have his present contract and specifications modified as follows:

"The contractor to be paid 14 cents per cubic yard for actual dredging.

"The dredged material to be deposited at a distance of at least 40 feet from the edge of the cutting.

"The dumpage to be allowed on both sides of the cutting.

"The dumpage to rise not more than 3 feet at any point above the surface of the marsh, with 6 inches further allowance for isolated lumps of sod or hard mud.

"No clear berm to be insisted upon, but all dumpage flowing back into the cutting to be redredged at the contractor's expense.

"The above described dredging to be measured "in situ."

"The contractor to be allowed, if he chooses, but at his own expense, to build a retaining-wall not less than 6 feet from the cutting and not more than 6 inches high, to keep the dumpage from flowing back into the cut.

"Caves, occurring in the near vicinity of places where the contractor has failed to comply strictly with the above requirements, to be redredged at the contractor's expense. Other caves to be redredged at the expeuse of the United States, and this dredging to be measured in the buckets or in place after redumpage.

"Nothing extra shall be paid for removal of stumps of less than 1 yard diameter across the roots, nor for logs of less than 10 feet length or 6 inches diameter, nor for either stumps or logs unless firmly imbedded in the mud. Larger logs embedded in the mud shall be removed at the following rates, the dimensions to be taken from the logs and stumps after their removal: A log 10 feet long by 10 inches average diameter, for $5; other logs at corresponding rates, proportionate to the product of their length by their average diameter. A stump whose roots cover an area of 5 square yards, for $5; other stumps in proportion to the area covered by their roots."

To this he replied that he could not accept them; that the material was too treacherous for him to undertake to handle it in any way except to furnish the dredge well equipped and obey any orders that the engineer in charge might be pleased to make; that he thought he was entitled to some consideration from the United States Government from the fact that he undertook at the cost of *several thousand* dollars to execute a contract where the specifications could not be worked; that he was still willing to return to the work early in the autumn, *provided*, that the contract be so modified as to strike out from the original contract the words "upon a basis of 50 cubic yards per hour, a pro rata deduction to be made for all dredged below that amount and a corresponding increase for all dredged above it," so *that he should receive* $4.98 *per hour for use of machine*, and should not be required to assume any responsibility as to how the work should be done.

In my opinion the contractor's suggested terms are not advantageous nor economical to the United States.

After due consideration of all the above, I think that the present contract should be annulled; that the present contractor shall not be classed as a failing contractor, but shall receive the 10 per cent. of his retained pay ($14.62), and that new proposals should be invited from other contractors upon new specifications, with the following provisions:

The dredged material to be dumped at a distance of from 40 to 180 feet from the edge of the cutting, in each case equal to ten times the depth of the soft mud at the point of dredging.

This dumpage to be allowed on both sides of the cutting.

The ridge of the cutting not to rise more than 3 feet on the average above the general surface of the surrounding marsh or mud flat.

No clear berm to be insisted upon, but all dumpage flowing back into the cutting, and all caving banks of any sort to be redredged at the contractor's expense.

The above described dredging to be measured in situ and paid for by the cubic yard.

Nothing extra shall be paid for removal of stumps of less than 1 yard diameter across the roots, nor for logs of less than 10 feet length or less than 6 inches diameter, nor for either stumps and logs which lie loosely in the mud. Large logs embedded in the mud shall be removed at the following rates, the dimensions to be taken from the logs and stumps after their removal: A log 10 feet long by 10 inches average diameter, for $6; other logs at corresponding rates, proportionate to the product of their length by their average diameter (for example, the removal of a log 30 feet long and 30 inches diameter will cost $54). A stump which, with its roots, covers an area of 5 square yards, for $7; other stumps in proportion to the area covered (for example, the removal of a stump which, with its roots, covers an area of 5 yards by 4 yards, will cost $28).

A copy of the present specifications is inclosed.

Very respectfully, your obedient servant,

W. H. BIXBY,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

[First indorsement.]

UNITED STATES ENGINEER OFFICE,
Baltimore, Md., May 26, 1885.

Respectfully forwarded to the Chief of Engineers. * * *

Captain Bixby's recommendations are approved, unless it be thought better to suspend the work entirely until the whole subject can be thoroughly reviewed and brought specially to the notice of Congress. Reference to the history of the whole scheme, of which the work now under consideration is a small part, and to the great disproportion of the entire cost and the appropriation available, leads me to look on the expenditure of this appropriation *by itself* as probably a waste of money.

W. P. CRAIGHILL,
Lieutenant-Colonel of Engineers.

[Second indorsement.]

OFFICE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
May 29, 1885.

Respectfully returned to Capt. W. H. Bixby, Corps of Engineers.

The contract may be terminated, with consent of parties, upon a proper modified agreement, to be approved by the Secretary of War, setting forth the reasons upon which it is based and the necessity therefor.

The views of Lieut. Col. W. P. Craighill, Corps of Engineers, as set forth in the preceding indorsement, are concurred in, the work to be suspended until the whole subject can be thoroughly reviewed and brought especially to the notice of Congress, as suggested by him, when noted to be returned.

Through Lieut. Col. W. P. Craighill, Corps of Engineers.

By command of Brigadier-General Newton.

JOHN G. PARKE,
Colonel of Engineers,
Bvt. Maj. Gen., U. S. A.

Third indorsement.]

UNITED STATES ENGINEER OFFICE,
Baltimore, Md., June 2, 1885.

Respectfully transmitted to Capt. W. H. Bixby, Corps of Engineers, U. S. A.

WM. P. CRAIGHILL,
Lieutenant-Colonel of Engineers.

Further work awaits the further action of Congress.

Recommendations for future work are as follows: That this improvement be extended in general accord with the present approved and adopted project over the whole distance through the New Berne and Beaufort Canal, as well as through Clubfoot River and Harlowe Creek, so as to secure a through channel of 5 feet depth, at mean low water, and 30 feet bottom width from the mouth of Harlowe Creek to the mouth of Clubfoot River, thus completing a 5-foot navigation from New Berne to Beaufort at a total expense of $90,000 (including the funds, $7,925.69, now available), this amount to be appropriated in two yearly instalments of $50,000 and $40,000 respectively. The dangers of ocean travel around Cape Hatteras are so great that some such 5-foot navigation for small vessels appears necessary between Pamplico Sound and Beaufort Harbor, and no similar navigation can be secured by any other route, except at greatly increased expense. Further improvement over this route, so as to secure a channel of more than 5 feet depth at low water, is not recommended at present.

This work is in the collection districts of Beaufort and Pamplico, N. C.

Money statement.

July 1, 1884, amount available (see Neuse River and Beaufort Harbor for 1882–'84)		$9,805 60
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$1,720 43	
July 1, 1885, outstanding liabilities	159 48	
		1,879 91
July 1, 1885, amount avaiable		7,925 69
Amount (estimated) required for completion of existing project		50,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		50,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

REPORT OF MR. R. RANSOM, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
New Berne, N. C., June 29, 1885.

CAPTAIN: I have the honor to submit the following report of operations upon Harlowe Creek, "Inland Line of Navigation, New Berne to Beaufort," N. C.

The reports of Captain Mercur, Corps of Engineers, and Assistant Engineer J. P. Darling, relating to this work, made in 1883, render an elaborate description of the locality by me unnecessary.

In October last you indicated, in person, the line along Harlowe Creek where the work was to be done. Previous to your assuming charge of the district, the "project" had been determined by the Engineer Department, and a contract entered into by your predecessor, Captain Hinman, Corps of Engineers, with T. P. Morgan, of Washington, D. C., for the execution of the work.

The project required a channel 30 feet wide at bottom and 4 feet depth at mean low water, to be obtained through Harlowe Creek. This took into consideration the great "Inland Line of Navigation" contemplated in the survey made under direction of the late Captain Phillips, Corps of Engineers, in 1878–'79.

The appropriation for this particular work was $10,000 derived from $5,000 taken from former appropriations for Neuse River and Beaufort Harbor, each.

I was assigned to the direct execution of the work, and Col. S. L. Fremont put on duty as inspector in October last.

On October 29, 1884, the contractor's first dredge, an ordinary dipper machine, arrived at the point where the work was to begin. I will here state that the con-

tractor had never seen the locality and made the contract without any examination as to what might be required. The specifications of the contract exacted that a clear berm of 12 feet should be left between the edge of the cut and the dredged material, and that the embankment made should not be over 4 feet high at any point. Before the dredge left Beaufort Harbor for the point of beginning, I told the contractor's agent it could not execute the work as the contract stipulated. A full and repeated trial proved that the dipper machine was unequal to the work of throwing the mud sufficiently far. Several changes were attempted to fit this dredge for the work, but failed. On the December 19, 1884, a grapple dredge was put on the work. That succeeded somewhat better, but very soon it was demonstrated that the marsh could not support the imposed material taken from the cut, and caving took place as dredging was done.

By your directions I experimented upon the construction of a flooring upon the marsh for 100 feet up and down the stream 40 feet wide. The first flooring consisted of inch board doubled crosswise (this was the only lumber to be obtained quickly). The board covering was insufficient to save the marsh from crushing beneath the weight of dumped mud. A second flooring consisted of small logs about 6 inches in diameter and 40 feet long covering a similar area. This supported the mud tolerably, but some caving followed even this, and retaining walls next the berm were required to hold back the mud. The grapple dredge proved unequal to carrying mud sufficiently far from the cut to keep the embankment down to 4 feet high.

The grapple dredge stopped work January 31, 1885. After this nothing further was attempted by the contractor. The grapple dredge left on February 6, and the dipper dredge on March 12, 1885. Not quite 1,500 cubic yards of excavation was credited to the contractor.

By your direction a resurvey of Harlowe Creek was made under my supervision by Mr. R. P. Burks, surveyor. Bench-marks were established, the high and low water lines marked, the whole line of cut, as indicated by you, staked out in detail, and the location and size of the "oyster rocks" near the mouth of the creek mapped. Soundings along the channel and likewise soundings of the mud beneath the channel, and marsh 25 feet each side of the channel were taken with an iron rod down to hard material by Inspector Fremont. Over the short distance dredged the inspector sounded before and behind the dredge, taking cross-sections and measurements as far as dredged.

Tabulated statements and maps of these various operations from time to time have have been sent to you.

I regret that no material advance in the work was accomplished, but circumstances not within my control prevented better results.

Having studied closely the nature of this locality and knowing the present needs of the people interested, while I believe I understand the difficulties to be met in executing work upon this line, I presume to express my opinion as to what should be attempted on it to meet the present demands of commerce.

As the Government has not apparently settled upon the policy of opening the "Inland Line of Navigation" along the entire coast from Norfolk to Wilmington, and the estimates are of such magnitude that until that policy is disposed and provided for by commensurate appropriations, all that should be attempted with the small appropriations usually at our disposal is to utilize the natural channel by dredging it out with as little excavation as possible, trimming the banks when absolutely necessary to widen, and at short turns removing stumps and logs, with a view to obtain a depth of water, at mean high tide, of 4 feet. This depth is decided upon because the lower end of the creek is slightly over a foot deep at low tide, over much of the distance, and to secure a greater depth where the mud is from 15 to 20 feet deep, and spreads for a quarter of a mile wide of the consistency of soft mortar, would require outlays which could not be met by ordinary appropriations.

With the above suggested work done I am confident communication for small boats would be established between New Berne and Beaufort at once through the canal connecting Clubfoot and Harlowe Creek, as enlarged and deepened by a private corporation along the line of the old "Clubfoot and Harlowe Canal."

I am indebted to Surveyor Burks for his faithful and accurate work and valuable assistance; and the details of the work assigned to Inspector Fremont illustrate his fidelity and the value of his services.

Very respectfully, your obedient servant,

R. RANSOM,
Assistant Engineer.

Capt. W. H. BIXBY,
Corps of Engineers.

M 5.

IMPROVEMENT OF BEAUFORT HARBOR, NORTH CAROLINA.

Owing to its experimental nature, its variable features, and the difficulty of properly specifying it beforehand and inspecting it afterwards, the work was allowably done by hired labor and the purchase of materials in open market.

The special work of the year was as follows:

Work was continued during the entire year.

At Shackleford Point the main jetty was crowned with a concrete capping, 444 feet long, 6 feet wide, and 3 feet high, in blocks of 20 feet length. The sea end of jetty is being slowly undermined, and much heavy stone and over one hundred bags of cement were piled and packed around it during the year. Constant repairs will be yearly necessary.

A new jetty, 400 feet long, was built on the northern shore of Shackleford Point, 2,300 feet east of the main jetty, to prevent further erosion of this point by the North River ebb current; 3,081 cubic yards of rubble were used thereon with excellent results.

The small jetty 100 feet long, built in 1882, between these two jetties, has almost disappeared from being gradually washed away.

About 721 linear yards of brush and stone revetment, 15 feet wide, were also placed along the shore between the main and eastern jetties to protect the shore from further erosion by the North River ebb current, and with excellent results so far.

Tide-gauge records were kept a portion of the year.

At Fort Macon Point.—A revised project for the improvement of this harbor was submitted and approved. This project provided for a survey of the harbor, and for the future protection of Fort Macon Point. The important reasons therefor are shown in the appended correspondence.

A cut through the sand banks west of the fort, was closed by a sand-filled crib work, 9 feet high, 12 feet wide, and of 420 feet total length, at a total expense of $4,300.

A small wharf is being newly constructed to receive the material used in the Beaufort Harbor work at a total cost of $350.

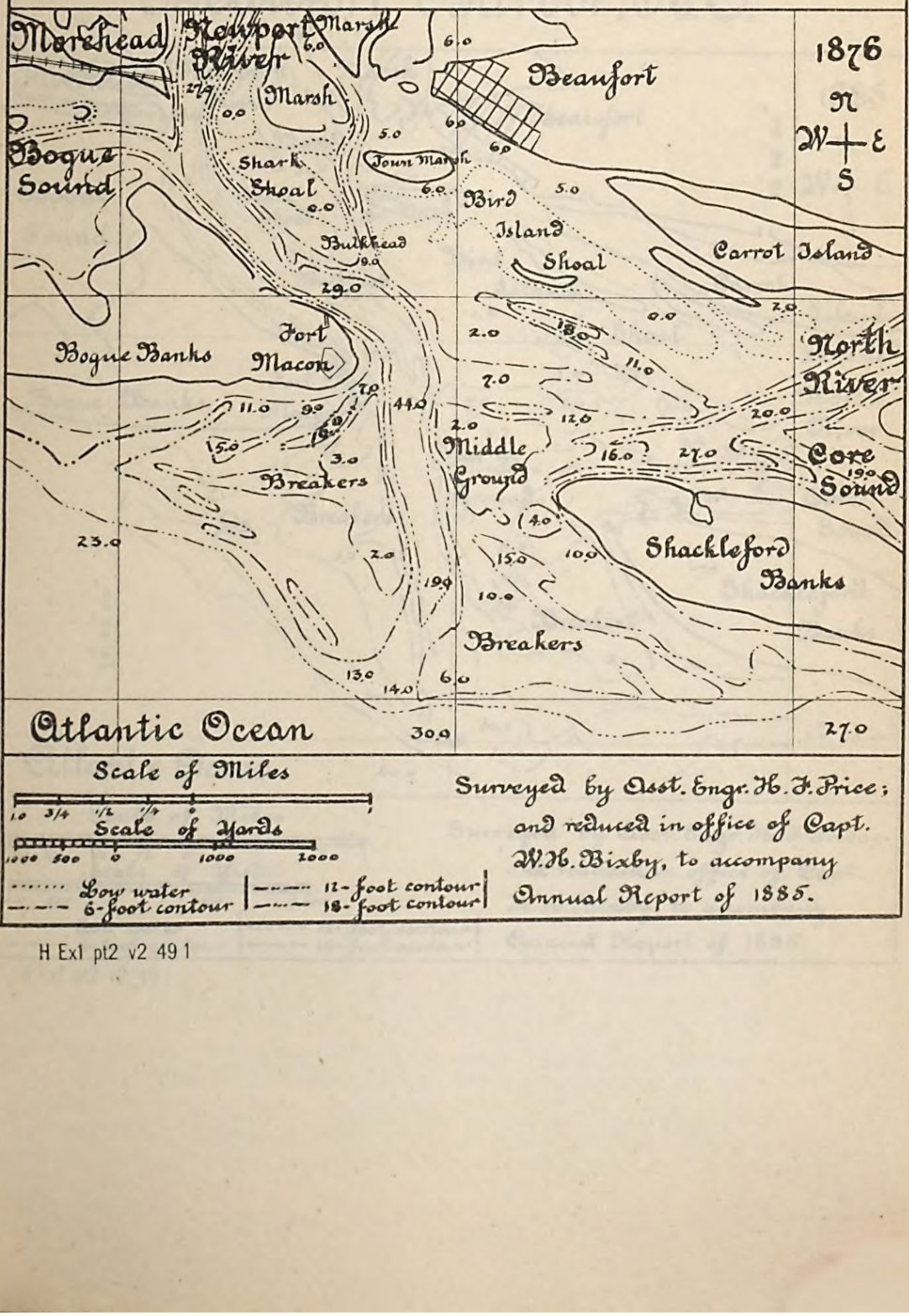
A new jetty was located northwest of the fort, to secure the northern shore of Fort Macon Point from further erosion by the Newport River ebb current, and 40 linear feet of foundations laid.

A careful survey of the harbor, especially on the ocean side, is being made to serve as basis for a careful project for further protection of the harbor entrance.

The survey of the harbor is being made by Assistant Engineer H. F. Price. All the other work has been done under the immediate supervision of Assistant Engineer R. Ransom. Both assistants have well and vigorously carried on the work under their charge.

Recommendations for future work are as follows: That the present approved projects be completed, so far as to thoroughly protect Shackleford and Fort Macon from further erosion ($80,000), and to dredge a reduced channel of 100 feet width and 5 feet depth at low water from Bulkhead Channel entirely through to Beaufort City ($4,000) at a total expense of $84,000 (in addition to the $2,218.56 which is now available), this amount to be appropriated in one sum during the next year. It is further recommended that this project be extended so as to protect the bar entrance from further deterioration, and so as to thoroughly re-establish this valuable harbor and bring back the depth of water on its

Beaufort Harbor. N.C.



Scale of Miles

1.0 3/4 1/2 1/4 0

Scale of Yards

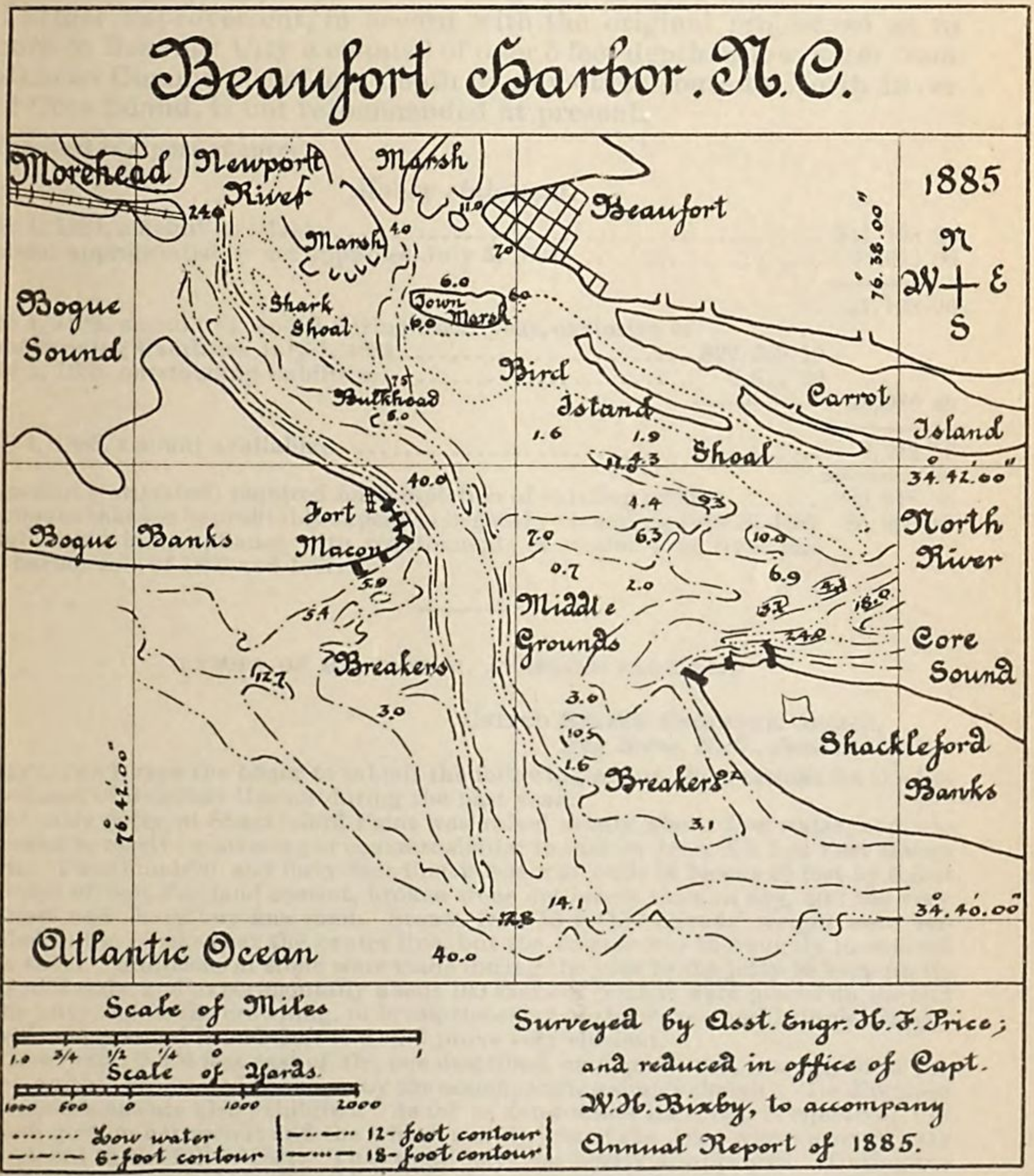
1000 500 0 1000 2000

..... Low water
—.—.— 6-foot contour
—.—.— 12-foot contour
—.—.— 18-foot contour

Surveyed by Asst. Engr. H. F. Price; and reduced in office of Capt. W. H. Bixby, to accompany Annual Report of 1885.

H Ex1 pt2 v2 49 1

Beaufort Harbor. N.C.



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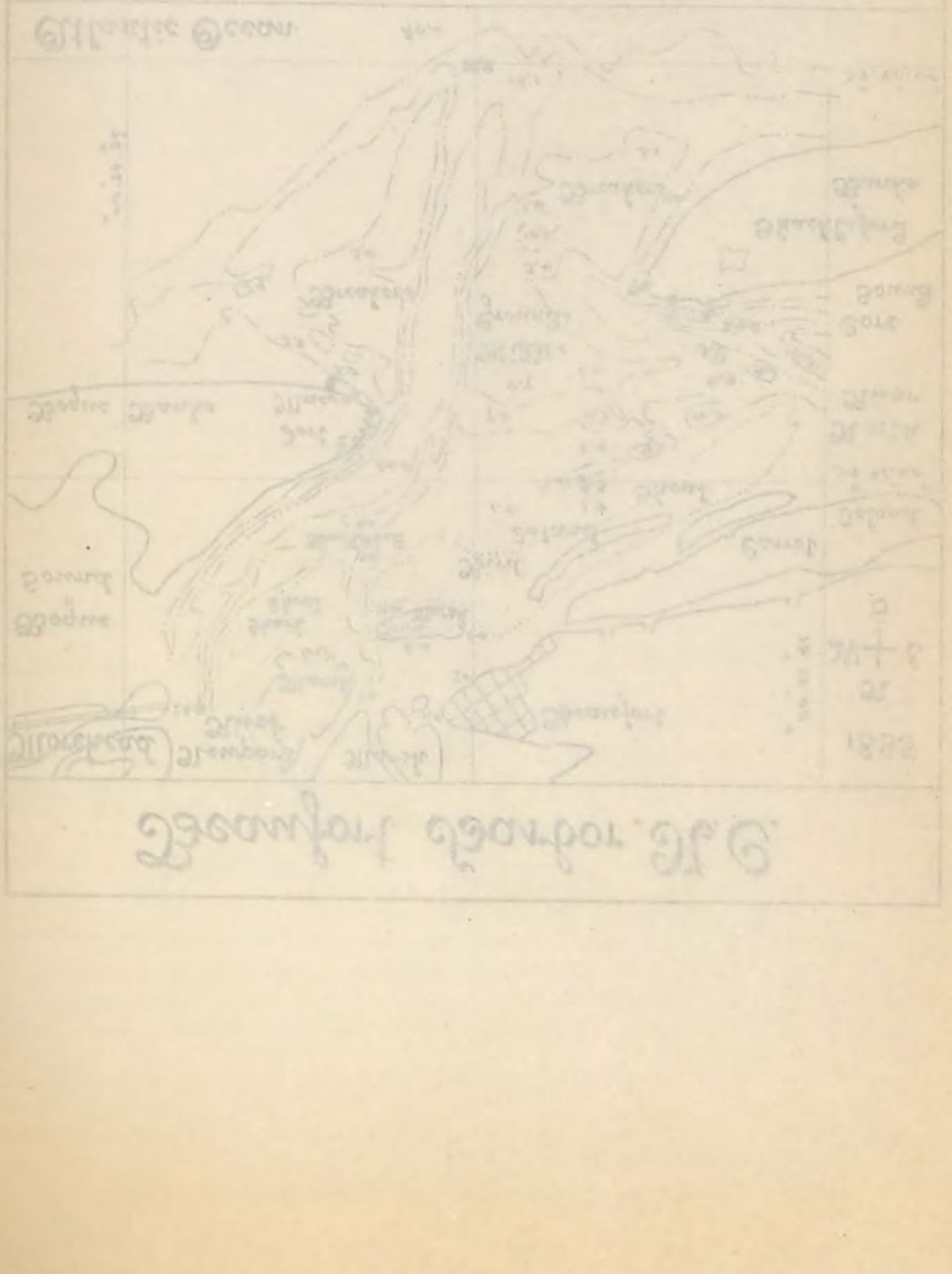

bar entrance to 18 feet least depth at low water, as it is said to have been in 1737 and in 1830. It is not possible at the present moment to tell exactly what it will cost to permanently protect the harbor entrance from all further deterioration, as the present survey of the harbor is not completed, and as marked changes and deterioration of both channel and bar are known to have taken place since the last survey of 1874. One hundred and fifty thousand dollars is probably a moderate estimate for this work, and it should be appropriated at once in a single sum as soon as this projected improvement is finally decided upon.

Further improvement, in accord with the original project, so as to secure to Beaufort City a channel of over 5 feet depth at low water from Bulkhead Channel, or of any depth by any other route to North River and Core Sound, is not recommended at present.

Beaufort is a port of entry.

Money statement.

July 1, 1884, amount available		$11,198 96
Amount appropriated by act approved July 5, 1884		20,000 00
		31,198 96
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$22,369 10	
July 1, 1885, outstanding liabilities	6,611 30	
		28,980 40
July 1, 1885, amount available		2,218 56
Amount (estimated) required for completion of existing project		86,218 56
Amount that can be profitably expended in fiscal year ending June 30, 1887		84,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

REPORT OF MR. RANSOM, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
New Berne, N. C., June 30, 1885.

CAPTAIN: I have the honor to submit the following report of operations for the improvement of Beaufort Harbor during the past year:

The main jetty at Shackleford Point was raised evenly above low water, and was prepared to receive a covering of concrete similar to that on Jetty No. 1 at Fort Macon Point. Four hundred and forty-four linear feet was built in blocks 20 feet by 6 feet by 3 feet of best Portland cement, broken stone not larger than an egg, and the very cleanest and sharp but fine sand. Stones from 15 to 150 pounds' weight were embedded in the blocks near the center line, but the mortar was thoroughly in contact with them. Additions of stone were made during the year to the jetty to keep up its sides and ends, and experimentally about 100 sacks of cement were placed on the end of the jetty, below the crowning, to break the effect of the waves, and I think a larger experiment justifiable and that it would prove very efficient.

A new jetty, 2,300 feet east of the one described, on Core Sound, was begun in October, and has progressed as shown by the accompanying simple sketch*. Its direction and dimensions are also exhibited. As far as determined its action is effective; but erosion goes on between it and the wharf, mainly just at the point where a small jetty was placed in the fall of 1882. That small jetty has nearly disappeared. During the year a simple revetment of brush 8 or 10 feet wide, loaded with stone sufficient to hold it down, has been laid along the high-water line in this vicinity and extends over some 600 feet. This was put in by your direction and its effect to this time is beneficial.

West of Fort Macon were two cuts to be closed, and they have been effectively closed by most substantial crib-work after the directions furnished by you. I will briefly describe them:

First. A line of upright piles of long-leaf pine, not less than 1 foot diameter at small end, were sunk 6 feet below surface of lowest point in cuts, and into and behind these were built cribs, all united, of logs 23 feet and 15 feet long, to 9 feet above the base.

The base horizontal logs are 2 feet below the surface. The whole structure is thoroughly notched and spiked with long wrought-iron rods. Two horizontal stringers run along the front face, one 2 feet below the surface of the cuts and the other just above the highest cross-logs and resting upon them. This upper stringer is tied back to the interior partitions by inch-iron rods. There are three partitions longitudinally. The front one is ceiled on its sides, the middle one is unceiled, and the rear one is ceiled and floored. The front and rear ones are two-thirds filled with sand in bags, the middle one the same with loose sand. The accompanying sketch * gives a correct idea of the work. One cut has ten pens and the other eleven pens of crib-work, aggregating 420 feet. In time it is proposed to crown the cutting with a sand fence.

At Fort Macon Point the shore end of Jetty No. 1 is to be extended back, and a foundation has been laid for over 100 feet; first of logs, and then covered with stone up to a level with the base of the concrete crown.

A new jetty has been started west of the wharf, about 125 feet from and west of the old railroad, which ran from an old wharf to the fort, and will be extended about 250 feet to a pile of stone formerly deposited in the channel. Forty feet of the foundations are laid for this work. It is of logs 40 feet long and not less than 8 inches diameter at their small end, made into mats of 15 feet width, and securely bound by cross-ties with wrought-iron spikes. They are loaded with rubble-stone and sunk into position.

A new wharf of 48 feet frontage, 30 feet broad, with a 16-foot approach, is now under construction and nearing completion. This is substantially, but economically, built. The teredo destroy timber very rapidly in this water.

Lumber has been secured to repair the large scows, and is on hand.

Cement is on hand for crowning inrer end of Jetty No. 1.

The original project contemplated work only at Shackleford Point. It was intended to run jetties at intervals around it, extending into the sea and sound. This work is tentative, and I hardly know how to estimate for it.

To complete the new eastern jetty in Core Sound, at Shackleford Point, will require about 1,000 cubic yards of rubble-stone to bring it to a foot above high water. If crowned, the concrete must be estimated for.

To finish jetty now started at Fort Macon to 1 foot above high water will require 1,800 yards of rubble-stone, and if it is to be crowned with concrete an additional cost is to be considered.

I respectfully recommend that the two jetties, now started with rubble, be raised to at least a foot above ordinary high water, and that the jetties 2 and 3, outside and west of No. 1, be crowned with concrete similar to No. 1 at Fort Macon.

For these works to be completed as recommended, the rubble-stone in position will cost about $3 per cubic yard, and the concrete $11.50—that is, to finish the new jetty eastward of Shackleford Point will cost not less than $7,000, the new jetty near wharf at Fort Macon about $6,000, and to crown the two outside jetties at Fort Macon $7,000.

It will probably be found necessary and desirable to put two other jetties east of the main jetty at Shackleford Point inside and one outside. These will cost about $12,000 each.

Until the last-named jetty, now started at Fort Macon Point, near wharf, is completed, I forbear a recommendation for others between that and No. 1, as it is advisable to await the action of the one furthest inward.

It is hoped the present appropriation will complete No. 1, as to crowning it 120 feet nland with concrete, and finish the wharf now under construction.

For engineering work will be needed upon eastern jetty at Shackleford...	$7,000
Jetty near wharf, Fort Macon Point.....	6,000
Concrete crown, Nos. 2 and 3, Fort Macon Point.....	7,000
Three other jetties, Shackleford Point.....	36,000
Supervision.....	5,600
Contingencies	6,160
Making a total of.....	67,760

for present work upon the main points on each side of the entrance to the harbor.

An expenditure of a liberal amount might be made to improve the channels from the sea channel and from Core Sound to the town of Beaufort, and between Morehead City and Beaufort. No recent survey has been made, and I am not prepared to recommend the particular routes to be followed in those desirable and to the people of Beaufort necessary improvements.

By your direction Mr. H. F. Price is now conducting a survey of part of the harbor at least, and will make his report directly to you.

Accompanying this is as complete a statistical table of commerce as I have been able

* Omitted.

to obtain; and likewise tracings by Mr. R. B. Burks, surveyor, showing present contours of Shackleford and Fort Macon points, and of the crib-work west of Fort Macon.

I take pleasure in expressing my thanks to Mr. Burks for his faithful attention to every duty and the correctness of his work; and to Mr. John A. Dill, overseer, to whom I am under lasting obligations for his zeal and ability in discharge of executive duties both important and difficult.

Mr. W. F. Howland, collector of customs at Beaufort, N. C., through his assistant, Mr. L. A. Potter, has kindly collected and transmitted the commercial statistics.

Very respectfully, your obedient servant,

R. RANSOM,
Assistant Engineer.

Capt. W. H. BIXBY,
Corps of Engineers.

COMMERCIAL STATISTICS OF BEAUFORT, NORTH CAROLINA.

[Vessels.—Larger class, 15; tonnage, 800; smaller class, under 20 tons, 68; steamers, 3.]

Outward shipments.		Quantity.	Value.
Fish scrap	tons	2,000	$50,000
Fresh fish	do	1,500	150,000
Salt fish	barrels	6,000	24,000
Clams	do	6,000	12,000
Oysters	do	80,000	24,000
Irish potatoes	do	5,000	3,000
Sweet potatoes	do	15,000	4,500
Corn	do	20,000	12,000
Rice	do	10,000	10,000
Watermelons		100,000	8,000
Cotton	bales	2,500	10,000
Oil	barrels	2,000	40,000
Total			437,000

The above aggregate about 12,500 tons, exclusive of large shipments of truck and other articles.

Vessels bringing ice and fertilizers from the north return loaded with lumber, staves, and shingles.

The inward freights exceed the outward in tonnage.

Trade through Core Sound, from the more northeastern counties of North Carolina, bordering its inland waters, is carried through Beaufort Harbor and Inlet to Charleston and Wilmington, consisting largely of corn and rice, the vessels avoiding the dangers of Lookout and Hatteras.

R. RANSOM,
Assistant Engineer.

LETTER OF THE COLLECTOR OF CUSTOMS AT BEAUFORT, NORTH CAROLINA.

CUSTOM-HOUSE, BEAUFORT, N. C.,
Collector's Office, July 11, 1885.

DEAR SIR: In compliance with your request I take pleasure in furnishing you with the following, &c. I have made for you the following estimates, based upon calculation and from the records in this office, of the present commerce of the port of Beaufort. In the custom-house at Beaufort are enrolled fifteen vessels (sail), aggregating about 800 tons; sixty-eight vessels under 20 tons each, and three steamers. These are all employed in the commerce carried on in Beaufort Harbor, and in addition thereto about one hundred and fifty small sail and pole craft are continually employed in and about the harbor.

The principal products of this country, nearly all of which are conveyed by water through this harbor to the markets, embrace annually about 6,000 barrels of clams, 80,000 bushels oysters, 15,000 bushels sweet potatoes, 2,500 bales of cotton, 100,000 watermelons, 10,000 bushels rice, 20,000 bushels corn, 5,000 bushels Irish potatoes, 2,000 barrels oil, 4,000,000 pounds fish scrap, 6,000 barrels salt fish, besides about 1,500 tons fresh fish, aggregating 12,500 tons, exclusive of the extensive shipments of miscellaneous truck and smaller productions, which run up to a considerable amount.

In addition to these enumerations, several saw-mills in this county make frequent shipments of lumber, staves, and shingles to northern markets, keeping a number of

vessels belonging to other ports in regular employ. This harbor is also the outlet for much of the produce of Onslow County, the amount of which I cannot determine.

The inward freights, consisting for the most part in merchandise, machinery, fertilizers, and ice, will exceed in tons the outward shipments, the two latter-mentioned articles being imported coastwise in large quantities for interior towns and cities.

A constant trade is carried on through Core Sound and this harbor by vessels employed in moving the products of corn and rice from nearly all the eastern counties of North Carolina to Charleston and Georgetown, S. C., and Wilmington, N. C.; this port being the only safe and convenient exit to the sea, and affording these coasting vessels an opportunity of avoiding the dangers of Capes Hatteras and Lookout. Our people appreciate the great good already accomplished by the works here in your charge, and many of the fears of which they were possessed because of the encroachments of the sea have been allayed since they have seen the waters stayed by the jetties so far completed.

We have great hopes for the future of our fine harbor, and nearly the whole State is interested in its protection and improvement.

Trusting the appropriations begun by the Government will be continued or increased so that you may complete the work which has been so satisfactorily prosecuted under your skillful management, I remain, yours to command.

W. F. HOWLAND,
Collector,
Per L. A. POTTER,
Deputy Collector.

General R. RANSOM,
Assistant Engineer.

REVISED PROJECT FOR BEAUFORT HARBOR IMPROVEMENT.

UNITED STATES ENGINEER OFFICE,
Wilmington, N. C., October 13, 1884.

SIR: I have to submit herewith the following remarks and revised project for the preservation of Beaufort Harbor, N. C., in accordance with the directions of the indorsement of your office of 26th September, 1884, and with the views of the supervising engineer as given in his indorsement of 23d September, 1884, both upon the letters from this office of 27th August, 1884, with reference to the protection of Fort Macon side of the above-mentioned harbor.

Referring to the report of the Board of Engineers of 6th December, 1881, it will be seen that Newport River and the adjacent sounds afford a tidal reservoir of sufficient capacity to preserve a minimum depth of 15 feet at the bar entrance and of 25 feet over the greater portion of a ship-channel of 4 miles length; this channel passing between Fort Macon on the west and Shackleford Point on the east, and extending from the ocean to Morehead City above Beaufort (see inclosed sketch).

A tendency to erode on the ocean face at Fort Macon Point was checked about thirty years ago by five spur-jetties of stone, and later by two others of stone; of these, four remain intact, two have settled, and one has disappeared. A tendency to erosion on the river-face was partially checked for awhile by the piers of an old wharf.

An erosion on the opposite side of the main channel at Shackleford Point was stopped later by the authorized construction of jetties at this point in 1882–'83–'84, of which one occupies the very end of the point itself, and one lies a short distance to the northeast.

Between Fort Macon and Shackleford Point the nominal width of opening has been 2,200 yards; in 1821 it was 2,250 yards; in 1839 it was 2,100; in 1876, 2,250; in 1880, 2,600; in 1881, 2,900 yards; the increase from 1821 to 1881 being 650 yards, of which about 120 yards have been worn from Fort Macon Point and about 530 yards from Shackleford Point. Since 1881 this 650 yards has been diminished by about

one-half; about 100 yards has been given up by the sea on the Fort Macon side, about 200 yards on the Shackleford Point side, and the total width being reduced to about 2,600 yards, as in 1880. I think that further contraction should be postponed until more is known of the present condition of the main channel. As far as this office is informed, the main channel has not been mapped since 1876. I think that the present opening can be easily maintained by the two main jetties as already constructed, provided that both points are properly protected in their rear.

The project for 1884, as submitted by my predecessor the 21st July, as indorsed by the supervising engineer 31st July, and as approved from your office 12th August, authorizes such protection for the Shackleford Point side of the channel, suggests a new survey, and alludes to the danger of overcontraction, but does not provide for any protection on the Fort Macon side, although it suggests such work.

At Fort Macon Point the storm and high waters have at least once of late cut across the inner end of the main jetty, and have twice made a clear cut through the south face of the sand ridge, about half a mile southwest of the point. The Newport River seems also to be cutting in upon the north face of the sand ridge, about a half mile west of the point, as if trying to combine with the sea to cut a new inlet across the Fort Macon Point, back and west of the fort. Such a cut, somewhat analogous to that of the New Inlet at the mouth of the Cape Fear River, is possible. The results of such a cut would be disastrous to the interests of Beaufort Harbor. I think that one or more jetties are needed on the east and north side of Fort Macon to prevent erosion by the current of Newport River; that the main jetty southeast of Fort Macon should be connected solidly with the bank on its rear to prevent the sea from cutting behind it; and that one or more jetties or dikes should be used on the south and west of Fort Macon (as already confirmed by indorsement of your office of September 26), to close the cut against the sea.

I have therefore to submit the following revised project for the expenditure of the money now on hand, about $30,000, appropriated by the act of July 5, 1884, and by previous acts, for the improvement of Beaufort Harbor, North Carolina.

It is now proposed to expend this sum at Fort Macon Point, as well as at Shackelford Point, in building one or more jetties, dikes, and sand fences, such as may be needed to protect the shore from erosion, to close cuts through its banks, and to retain the ground thus reclaimed; and also in making a resurvey of the harbor, such as may be needed to show the effect of the work done since 1881, and to serve as basis for the project of the coming year.

The experimental nature of the work renders impracticable the drawing up of definite specifications for actual constructions. It is therefore recommended that the work be done (as per indorsement of your office of August 12, 1884, on the previous project) by the hire of labor and machinery, by the use of the United States plant, and also by the purchase of machinery in open market whenever the officer in charge is prepared to certify that, in his judgment, such purchase will be "more economical and advantageous to the Government" than purchase by contract.

Very respectfully, your obedient servant,

W. H. BIXBY,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.
(Through Col. William P. Craighill, Supervising Engineer.)

[First indorsement.]

UNITED STATES ENGINEER OFFICE,
Baltimore, Md., October 20, 1884.

Approved, and respectfully forwarded to the Chief of Engineers.

WM. P. CRAIGHILL,
Lieut. Col. of Engineers.

[Second indorsement.]

OFFICE OF CHIEF OF ENGINEERS,
UNITED STATES ARMY,
October 23, 1884.

Respectfully returned through Lieut. Col. W. P. Craighill, Corps of Engineers, approved.

After such record has been made as may be necessary for the files of his office, Captain Bixby will return this paper to this office.

JOHN G. PARKE,
Acting Chief of Engineers.

[Third indorsement.]

UNITED STATES ENGINEER OFFICE,
Baltimore, Md., October 27, 1884.

Respectfully transmitted to Capt. W. H. Bixby.

WM. P. CRAIGHILL,
Lieut. Col of Engineers.

M 6.

IMPROVEMENT OF NEW RIVER, NORTH CAROLINA.

The amount appropriated by the act of 5th July, 1884, together with the funds then available, was regarded as too small for economical work, and therefore none had been approved.

The locations and surroundings of the proposed work were personally inspected in June, 1885. This inspection was sufficient to show that the improvement was much needed and was worthy of being made, and should be commenced as soon as the necessary funds could be obtained, that the present funds were insufficient for economical work, and that so far the previous recommendations and opinions were unquestionable, but the location of the present insufficient channel did not appear to be the best one to adopt for permanent improvement.

The newly-proposed channel will soon be located and examined and reported upon.

Recommendations for future work are as follows: That the present approved and adopted project, with slight modifications in details as may be thought necessary, be completed so as to secure a channel of from 100 to 150 feet width and 5 feet depth, at low water, from the ocean up to the upper river through about 7,000 feet of this oyster rock barricade, at a total expense of $40,000, including the funds now available, to be appropriated in a single amount, within the next year. Further improvement, so as to give a channel of greater depth or width, is not recommended at present.

This river is in the collection district of Beaufort, N. C.

Money statement.

July 1, 1884, amount available	$5,000 00
Amount appropriated by act approved July 5, 1884	5,000 00
July 1, 1885, amount available	10,000 00
Amount (estimated) required for completion of existing project	40,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	40,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

M 7.

IMPROVEMENT OF CAPE FEAR RIVER ABOVE WILMINGTON (FROM WILMINGTON TO FAYETTEVILLE), NORTH CAROLINA.

Owing to its experimental nature, its variable features, and the difficulty of properly specifying it beforehand and inspecting it afterwards, the work was allowably done by hired labor and the purchase of materials in open market.

The special work of the year was as follows:

Work was carried on slowly but continuously throughout the whole year. During this time the upper third of the river was thoroughly cleared of its visible obstructions; and the water-way at or within 2 miles of Fayetteville was contracted by the use of jetties, so as to give an increased depth during the summer low stage of water. At or within 2 miles of Fayetteville 1,142 linear feet of timber jetties and 300 linear feet of rock jetties were built, and 301 linear feet of old log jetties were sheeted upon their up-stream faces.

From 42 miles of river, between Elizabethtown (70 miles above Wilmington) and Fayetteville (112 miles above Wilmington), 4,760 snags, 1,073 logs, 596 stumps, and 150 cubic yards of loose rock were removed from the bed of the river, and 2,065 overhanging trees were cut from river banks.

Surveys were made of sixteen shoals where improvements are necessary, and maps of thirteen of these were finished. The locations of nine other shoals of lesser importance were determined to be surveyed as soon as the stage of water will allow a useful survey.

The jetties at Fayetteville are gradually producing the desired results, and so far are doing all that can be immediately expected from them. During freshets the river varies from 300 to 1,000 feet in width, 15 to 40 feet in depth, and 7 to 10 feet velocity per second, 5 to 7 miles per hour. During droughts the river is reduced to 150 feet width, 0.8 foot depth, and 1.8 feet velocity per second. Under these circumstances, and especially with an occasional, as has sometimes occurred, total of 204 cubic feet of water flowing per second through a natural cross-section of only 113 square feet, it is not to be expected that any works of mere contraction would assure a constant 3-foot depth of water. On the other hand, the present commerce is entirely too small to justify the necessary great expense of a slack-water lock-and-dam navigation.

So far the experience upon this river favors the use of long, low, closely-spaced rock jetties.

The small side-wheel steamer H. G. Wright, built for work upon this river, was remodeled. The addition of a suitable hull and the redisposition of her machinery, at a total expense of $800, gave her better ac-

commodations for her working crew, increased her speed from 3.5 up to 6.25 miles per hour, and reduced her draught from 26 inches to about 14 inches, so that she can now be advantageously used upon the work throughout the entire year.

Until his sudden death in September, 1884, the above work was well superintended by Assistant Engineer W. H. James. Since October, 1884, and up to the end of the fiscal year the work has been carried on with great vigor and thoroughness under the immediate superintendence of Assistant Engineer Charles Humphreys, whose report is appended.

Recommendations for future work are as follows: That this improvement be completed in accordance with the present approved and adopted project so as to insure a thoroughly cleared 4-foot channel from Wilmington (70 miles) to Elizabethtown; thence a similar 3-foot channel 42 miles further, to Fayetteville, at all ordinary stages of water, at a total expense of $200,000, including the funds ($5,986.17) now available; this amount to be appropriated in yearly installments of about $60,000 yearly. Further improvement, so as to extend the navigation above Fayetteville, or so as to increase its depth below Fayetteville, is not recommended.

This river is in the collection district of Wilmington, N. C.

Money statement.

July 1, 1884, amount available		$17,497 46
Amount appropriated by act approved July 5, 1884		5,000 00
		22,497 46
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$15,332 49	
July 1, 1885, outstanding liabilities	1,178 80	
		16,511 29
July 1, 1885, amount available		5,986 17
Amount (estimated) required for completion of existing project		200,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		60,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

REPORT OF MR. CHARLES HUMPHREYS, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Fayetteville, N. C., July 11, 1885.

CAPTAIN: I have the honor to make the following report on the improvement of Cape Fear River, North Carolina, from Wilmington to Fayetteville, for the fiscal year ending June 30, 1885:

By your orders I succeeded the late Capt. William H. James, assistant engineer, reaching the work early in October, 1884.

The official reports, in your office, give the following as the amount of work performed from July 1, 1884, to October 1, 1884:

From Fayetteville to a point 13.5 miles below, 104 rocks, 370 trees, 107 stumps, 216 logs, 991 snags, and a part of the wreck of the steamer Chatham were removed from the channel. Necessary repairs were made to the plant. Jetties were built as follows: At Fayetteville, Log Jetty No. 6, 125 feet long; Log Jetty No. 7, 115 feet long; at McCarter's Cross, one log jetty, 142 feet long; at McCrae's Cross, one sheet-pile jetty, 103 feet long, and at "Old Jetties," a portion of one log jetty. A combined dredge, hoister, and pile-driver was hired and sent to Elizabethtown, and a flat-boat about 60 feet long was built. Numerous examinations and sketches of the river were made. Freshets interfered with the above work.

The following is the amount of work performed from October 1, 1884, to June 30, 1885:

At Fayetteville, McCarter's Cross, and Old Jetties 12,590 cubic yards of sand, mud, and loose rock were dredged from the channel, of which amount 1,800 cubic yards

were thrown to one side by the dredge, the rest being dumped on flats and shoveled off near the shore between jetties. From Fayetteville to Elizabethtown, 42 miles below, 3,769 snags, 857 logs, 487 stumps, 1,695 leaning trees, a few loose rock, and a part of the wreck of the steamer Chatham were removed from the channel. Jetties Nos. 9 and 11, 55 feet from Jetty No. 1, and 12 feet from Jetty No. 6, were also removed. Sheet-pile jetties were built as follows: No. 4, 95 feet long; No. 5, 101 feet long; No. 8, 122 feet long; No. 10, 138 feet long; No. 13, 116 feet long; No. 16, 94 feet long; No. 17, 128 feet long, and No. 18 was commenced. Mats, weighted with mud, &c., were put at the outer ends of the above jetties. The following old log jetties were extended and sheeted: No. 1, sheeted 20 feet; No. 2, 108 feet; No. 3, 78 feet; No. 6, 122 feet; No. 7, extended 15 feet, sheeted 112 feet; No. 12, sheeted 110 feet. From an old abandoned lock and dam at Jones, 9 miles above Fayetteville, and from the river-bed, 1,051 cubic yards of loose rock and hard pan were quarried. Of this amount 959 cubic yards was loaded on flats, towed to Old Jetties, and deposited on the site of the new rock jetties being built, and 30 cubic yards were carried to Fayetteville to rip-rap Jetty No. 16. A steam-pump and water-jet attachment, for use in sinking the sheet-piling of the jetties, was obtained. A new hull was built under the steam-launch H. G. Wright, increasing her speed from 3.5 up to 6.25 miles per hour, and reducing her draught from 26 inches to about 14 inches, so that she could be used on the works throughout the whole year.

For the entire year the work of jettying and snagging can be summed up as follows: One thousand four hundred and forty-two linear feet of timber jetties and 300 linear feet of rock jetties were built; 301 linear feet of old log jetties, built before June 30, 1884, were sheeted; 4,760 snags, 1,073 logs, 596 stumps, 2,065 leaning trees, and 150 cubic yards of loose rock were removed from the channel. Surveys were made of Fayetteville Shoals, McCarter's Cross, Old Jetties, McCrae's Cross, Evans's Narrows, Rockfish, Smith's Cross, No. 3, Old Ferry, Thames, The Dodge, Prospect Hall, Windom, Callahan's, Melvin's, McDowall's Barn, and Elizabethtown. Maps were made and forwarded to you of all the above except Windom, Callahan's, and Melvin's. Projects were made for the improvement of these shoals sufficiently to determine the number of linear feet of jetties for the improvement of most of them. These projects are to a certain extent a compromise between what would probably give the best results in the future and what would be the simplest and cheapest at present, considering the existing low-water channel and jetties already built. Some of these projects ought to be revised before commencing actual work thereon.

Besides the shoals mentioned above, there will be more or less trouble at Cedar Creek, 11 miles below Fayetteville; Gray's Creek, 16 miles below; Devane's Ferry, 16.5 miles below; Government Mills, 46.75 miles below; Big Sugar Loaf, 48.5 miles below; Little Sugar Loaf, 49.75 miles below; Cypress, 52 miles below; Slingsby's, 55 miles below, and Brown's, 65.5 miles below. I have not surveyed these places yet, as a survey can only be properly made in low-water season.

A small clam-shell dipper ought to be obtained to put on the boom of steam hoister, to dig sand, logs, snags, &c.

The jetties at Fayetteville are gradually washing out the desired channel, but some of these jetties may have to be lengthened a little. They seem to be spaced at rather too great intervals, and I think future jetties on this river should be placed nearer together. It is found necessary to protect these jetties from undermining as fast as they are built. Several methods for doing this have been tried, and I believe the best results have been obtained with loose rock. Suitable rock can be readily obtained near Fayetteville if a small tram-road 1 mile long be built to the river bank. At present we have obtained the right to use a small quarry 6 miles above Fayetteville, 200 yards from the river. The stone from it cannot be brought away at a less stage of water than plus 4 feet.

The cross-sectional area of the river below dead low-water level, just above Fayetteville Shoals and 550 feet below the bridge, was 187 square feet on November 10, 1884, 257 square feet on April 27, 1885, and 244 square feet on July 6, 1885, while at a point 150 feet below the bridge it was 113 square feet on April 27, 1885. At Rockfish, below Rockfish Creek, a similarly measured cross-section showed 212 square feet on November 25, 1884.

In the above cases the maximum surface velocity did not exceed 1.8 feet per second at Fayetteville and 2.3 feet per second at Rockfish.

To give a thoroughly cleared and thoroughly contracted channel of 3 feet depth from Wilmington to Elizabethtown, and 2 feet depth from Elizabethtown to Fayetteville at all stages of water, I estimate from the past year's similar work that there is yet to be done—

15,000 snags, at $1, to be removed	$15,000
3,500 logs, at $1	3,500
2,000 stumps, at $2	4,000
7,000 leaning trees, at $1	7,00

2,000 cubic yards excavation, at $2	$4,000
48,000 linear feet jetties to build, at $2	96,000
Total	129,500
Superintendence, general and local, 10 per cent	12,950
Contingencies, 10 per cent	12,950
Grand total	155,400

To give a similar 4 feet depth from Wilmington to Elizabethtown, and 3 feet depth from Elizabethtown to Fayetteville, during the entire year, will require—

18,000 snags, at $1, to be removed	$18,000
5,000 logs, at $1	5,000
2,500 stumps, at $2	5,000
7,500 leaning trees, at $1	7,500
3,000 cubic yards rock excavation, at $2	6,000
63,000 linear feet jetties to build, at $2	126,000
Total	167,500
Superintendence, general and local, 10 per cent	16,750
Contingencies, 10 per cent	16,750
Grand total	201,000

The natural obstructions are exceedingly numerous and difficult of removal. Already during the years 1882, 1883, and 1884 the following obstructions have been removed: 8,687 overhanging trees, 2,188 trees, 2,230 logs, 2,005 stumps, 6,700 snags. (See annual reports to Chief of Engineers.)

In regard to statistics of commerce on the Cape Fear River between Wilmington and Fayetteville, I would respectfully forward the inclosed letter of G. W. Williams & Co., containing a statement of such commerce and its money value. I consider it a fair statement.

The Yadkin Valley Railroad at Fayetteville is pushing its road west, expecting, I am told, to have through connection to Cincinnati shortly; it already brings and receives a good deal of freight by way of the Upper Cape Fear to and from New York.

Very respectfully, your obedient servant,

CHAS. HUMPHREYS,
Assistant Engineer.

Capt. W. H. BIXBY,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

WILMINGTON, N. C., *July* 14, 1885.

DEAR SIR: Below we give you a statement of the commerce on the Cape Fear River, from Wilmington to Fayetteville, for the year ending June 30, 1885. We have compiled it from the actual figures of the business done by our own boats and from data furnished by the other steamboat lines.

Articles.		Quantity.	Value.
Cotton	bales	7,500	$375,000
Rosin	barrels	125,000	140,000
Spirits turpentine	do	25,000	450,000
Crude turpentine	do	1,500	2,200
Tar turpentine	do	33,000	40,000
Shingles	number	750,000	3,000
Guano	bags	115,500	345,000
Grain	bushels	60,000	50,000
Bacon	pounds	3,450,000	325,000
Molasses	barrels and hogsheads	4,938	50,000
Salt	sacks	17,300	10,300
Sugar	barrels	7,836	117,500
Hay	bales	9,900	10,000
Flour	barrels	27,800	166,800
Lumber	M feet	22,000,000	154,000
Miscellaneous merchandise	tons	7,500	.....
Passengers		7,500	.....
Total		.....	2,238,800

Cape Fear River N. C.

Fayetteville Shoals and Mc Carter's Cross

Surveyed and drawn under the Direction of

Capt. Wm H. Bixby Corps of Engrs U.S.A.

by Chas. Humphreys Asst. Engr.

June 30 1885

Scale 1" = 300ft

Aug 1884

Sheeted piling ////////

..... a line of end of jetties

Fayetteville Shoals

Mc Carter's Cross

Sheeting done by S. Bacon jr. July 7 1885

No 1	100	+4.2 O.L.W.	41' — Log jetty, since sheeted
No 2	125	+4.2 O.L.W.	122' — Log jetty, since sheeted
No 3	113	+4.2 O.L.W.	105' — Log jetty, since sheeted
No 4	128	+4.2 O.L.W.	95' — Sheet pile jetty
No 5	116	+4.2 O.L.W.	101' — Sheet pile jetty
No 6	115	+4.2 O.L.W.	122' — Log jetty, since sheeted
No 7	110	+4.2 O.L.W.	134' — Log jetty, since sheeted
No 8	100	+4.2 O.L.W.	122' — Sheet pile jetty
No 10	102	+4.2 O.L.W.	138' — Sheet pile jetty
No 12	115	+4.2 O.L.W.	123' — Log jetty since sheeted
No 13	102	+4.2 O.L.W.	116' — Sheet pile jetty
No 16	130		94' — +4.2 O.L.W. — Sheet pile jetty
No 17	128		128' — +4.2 O.L.W. — Sheet pile jetty

No 1	110'	Log jetty
No 2	125'	Log jetty
No 13	115'	Log jetty
No 16	110'	Log jetty
No 17	110'	Log jetty
No 9	120'	Log jetty
No 12	115'	Log jetty

23 ft

38 ft

48 ft

55 ft

W. H. Bixby
Capt Engrs.

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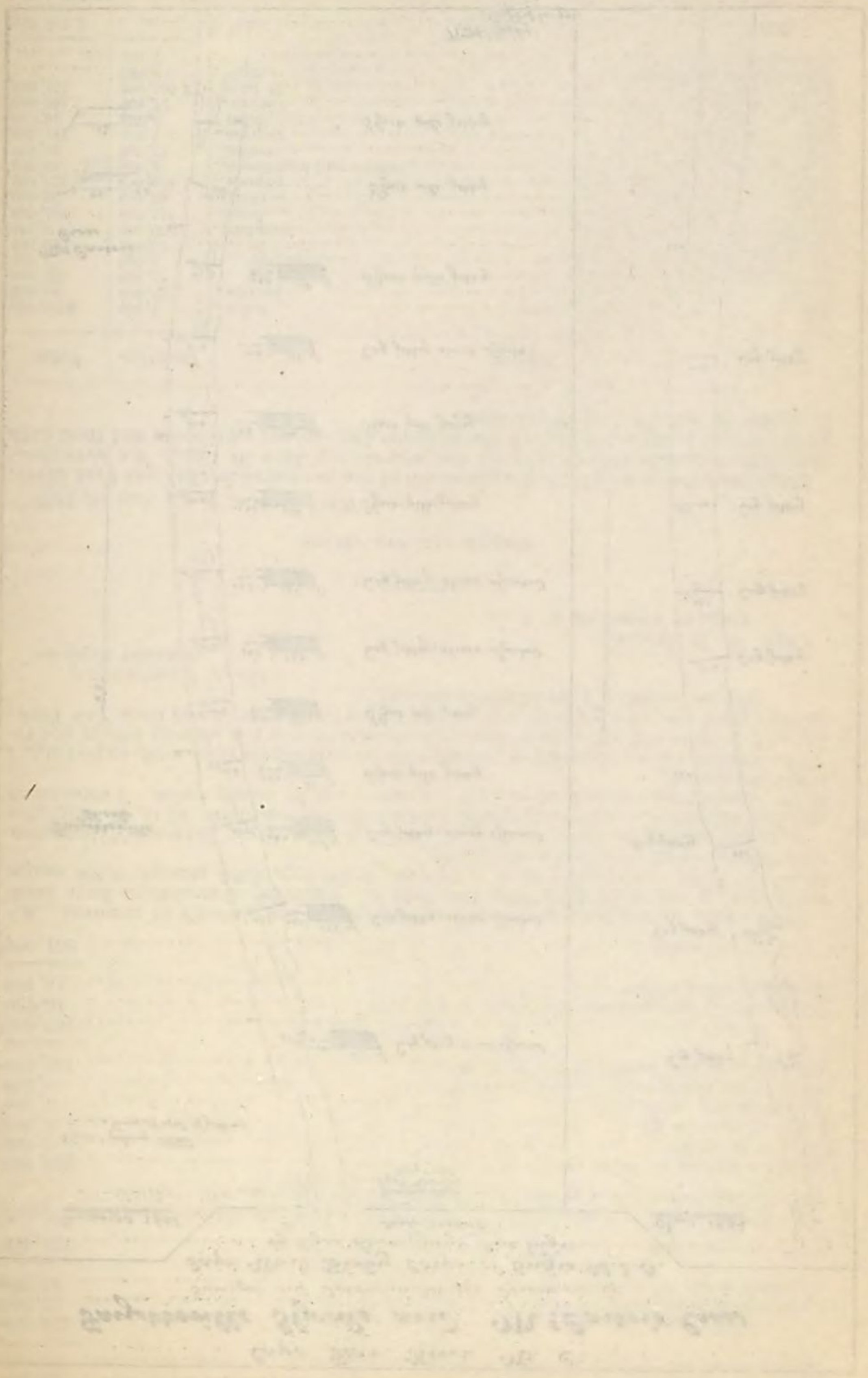


This does not include the miscellaneous merchandise or passengers, of which we cannot estimate the value without a great deal of trouble.

During this last year the traffic was almost entirely suspended during unusually low water for nearly three months, from September to the last of November, the most active business period of the whole year, and had the river been in boating order so that the boats could have made their regular trips, the increase in cotton alone would have been 5,000 or 6,000 bales, and other business at least 20 per cent.

The river is an important highway for a fine section of country, and capable of further development. We think there are twelve or perhaps fifteen post-offices on the river between here and Fayetteville, and the steamboats furnish the only means of communication with the outside world for the people living along the river for about 65 miles. Goods can be transported by water so much cheaper than by railroads, even if they existed through this section, that the importance of continuing the work to a successful issue will be readily seen.

Yours, respectfully,

GEO. W. WILLIAMS AND COMPANY,
Agents Express Steamboat Company.

Mr. HUMPHREYS.

M 8.

IMPROVEMENT OF CAPE FEAR RIVER BELOW WILMINGTON, NORTH CAROLINA.

Work was, as far as possible, done by contract, in accordance with the following abstracts of proposals.

By an uncompleted contract of last year, Messrs. Ross & Lara delivered 8,138.5 tons of stone, completing their contract early in September, 1884.

Abstract of proposals for furnishing stone for Cape Fear River, North Carolina, opened at 12.5 p. m., August 28, 1884.

No.	Names and addresses of bidders.	Where delivered.	Price per ton.	Remarks.
1	Ross & Lara, Wilmington, N. C	At their wharf.....	$1 48	Small, 9,000 tons.
2	G. Z. French, Rocky Point, N. C..	Wilmington, N. C.....	1 55	Heavy.
		At Government works..	1 75	Do.
		Wilmington, N. C.....	1 48	Small.
		At Government works..	1 68	Do.
		At Government works in 7 feet water.	1 70	As it runs in quarry.
3	C. H. Edwards, Boston, Mass.....	Smithville, N. C	3 90	Heavy.
4	Bodwell Granite Company, Rockland, Me.	Wilmington, N. C.....	2 33	Small.
			2 10	Heavy.
5	S. Perkins, Boston, Mass	.....do	2 37	Small.
			2 23	Heavy.
6	David Tillson, Rockland, Me	Smithville, N. C	2 15	Small.
			1 95	Heavy.
7	F. H. Smith, New York, N. Y.....	.....do	2 94	Do.
8	A. L. Lockwood, New York, N. Y...	.....do	1 99½	Small.
			2 03½	Heavy.
9	W. F. Haigh, New York, N. Y.....	.....do	2 35	Do.
10	Cuming & Brown, New York, N. Y..	Wilmington, N. C.....	3 19	Small.
			3 05	Heavy.
11	C. A. Brown, New York, N. Y	Smithville, N. C.....	1 95	All.
			1 95	
12	J. S. Howell, New York, N. Y.....	.....do	2 32	Do.
			2 32	
13	H. P. Gilbert, Georgetown, D. C....	.....do	2 77	Small.
			2 97	Heavy.

This contract was awarded half to Messrs. Ross & Lara and half to Mr. George Z. French. Messrs. Ross & Lara commenced work in September, 1884, and completed it in December, 1884, by full delivery of 9,094 tons of stone. Mr. George Z. French commenced work in September, 1884, and continued up to 30th June, having then de-

livered 20,362 tons of stone, both heavy and light. Owing to delays incident to the cold weather and heavy rains of the winter and spring, Mr. George Z. French's contract was extended up to 10th July, 1885; 1,640.5 tons of ballast stone were bought from ships from time to time at $1 per ton.

Abstract for proposals for a steam boiler for the United States steam tug James T. Easton, (improving Cape Fear River, North Carolina,) opened at 12.5 p. m., October 24, 1884.

No.	Names and addresses of bidders.	Price, delivered at Wilmington, N. C.	Alternate proposal for furnishing and putting in place on tug complete.		Time of completion or delivery.	Remarks.
			Where the job will be done.	Price.		
1	James Clark & Co., Baltimore, Md.	.....	Baltimore, Md.	$1,290	Seven weeks from date of contract.	$1,200 delivered on their wharf.
2	E. J. Codd & Co., Baltimore, Md.	$1,592	....do	1,742	Sixty days from date of contract.	No wood-work included in alternate proposal.
3	Warden & Mitchell, Philadelphia, Pa.	2,500	.....	.....	Two months after date of contract.	
4	Columbian Iron Works and Dry Dock Company, Baltimore, Md.	.....	.....	.....	Six weeks from date of contract.	$1,500 delivered on their wharf in Baltimore, Md.
5	John C. Froehlich & Co., Baltimore, Md.	.....	Baltimore, Md.	1,330	Six weeks from receipt of order.	$1,240 on their wharf, including joiners' work.
6	J. P. Morris & Co., Philadelphia, Pa.	1,450	Philadelphia, Pa.	1,530	Six weeks after date of contract.	$45 extra if supporting legs are required under furnace.
7	Robert M. Spedden, Baltimore, Md.	1,347½	Baltimore, Md.	1,345	Sixty days after date of contract.	
8	Burr & Bailey, Wilmington, N. C.	 2,200	Wilmington, N. C.	2,500	Nine weeks from date of contract. Six weeks	Wood-work to be done by the Government.
9	Samuel W. Skinner, Wilmington, N. C.	1,950	Wilmington, N. C.	2,500	Seventy days from date of contract.	
10	The Pusey and Jones Company, Wilmington, Del.	2,460	Wilmington, Del.	2,460	Six weeks after receipt of order.	
11	Theo. Smith & Bro., Jersey City, N. J.	1,650	.....	.....	Two months from acceptance of contract.	

Contract with John C. Froelich & Co.

Abstract of proposals for building two scows for improving Cape Fear River, North Carolina, opened at 12.35 p. m., October 22, 1884.

No.	Names and addresses of bidders.	Price for each scow.	Date of completion or delivery.
1	George W. Summerell, Wilmington, N. C.....	$980 980	Twenty-five days from receipt of order. Forty days from receipt of order.
2	G. H. Ferris, Baltimore, Md	945 945	

Rejected; price to high. Scows built by hired labor at $807 each.

Abstract of proposals for dredging Cape Fear River, North Carolina, opened at 11.5 *a. m., August* 28, 1884.

No.	Names and addresses of bidders.	How measured.	Price per cubic yard.	Remarks.
			Cents.	
1	Benson & McNee, San Francisco, Cal.	In situ.....	18½	
2	Sanford & Ross, Jersey City, N. J.	In scows....	14	$14 per hour for dredge when removing stumps.
3	Rittenhouse Moore, Mobile, Ala.	....do	14½	
4	George C. Fobes & Co., Baltimore, Md.	....do	14¾	$160 per day for removing stumps.
5	Morris & Cumings Dredging Company, New York, N. Y.	....do	14⅜	$15 per hour for stumps.
6	National Dredging Company, Wilmington, Del.	....do	12¾	Lilliput Shoal.
			14¾	Big Island and Log Shoal.
			23	Brunswick Shoal.
				$18 per hour for removing stumps.
7	Thomas P. Morgan, Washington, D. C.	....do	13 9/10	Lilliput Shoal.
			24	Big Island and Log Shoal.
			18	Brunswick Shoal.
			17 3/10	For all.
8	New York Steam Dredging Company, New York, N. Y.	....do	12½	$14 per hour for removing stumps.

This contract was awarded to Mr. Rittenhouse Moore. Mr. Moore commenced work with one clam-shell dredge on the 2d January, 1885, and added another suction-pump dredge in March, 1885, and continued work until the 30th June, 1885, having then removed 321,925 cubic yards of mud and sand, 5 logs, and 261 stumps from the dredged channel. Owing to unexpected delays, especially with the suction-pump dredge, Mr. Moore's contract was extended up to 31st October, 1885.

The special work of the year was as follows:

At the dike.—Ten thousand eight hundred and seventy-two tons of heavy stone and 28,363 tons of light stone were received and placed in position, so as to extend the dike to its full length, to raise it everywhere to ordinary high-water level, and to make it of nearly uniform strength throughout. Much more stone is still needed to complete the dike to its full dimensions.

At the shoals.—The dredging of this year was devoted to Brunswick River, Big Island and Lilliput Shoal, the only ones on the river where the depth at the beginning of the year was not already 16 feet at low water; 321,925 cubic yards of sand and mud, 261 stumps, and 5 logs were removed from the dredged channel, so as to complete a cut 74 feet wide and 16 feet deep at low water entirely through all of these shoals. Unexpectedly large quantities of logs and stumps have been found everywhere, and the work has been delayed in consequence thereof. The suction-pump dredge has so far failed to work, but it is expected to give excellent results as soon as it can be provided with a suitable feed-stirrer. The present 16-foot channel will probably be increased in width to 150 feet with the funds now available.

Special surveys were made at Snow's Marsh Channel, and showed for a great distance a certain amount of shoaling during the last two years. Authority was obtained to redredge the shoaled portion with the funds now available.

A careful survey was also made of the Midnight Shoals, dredged in 1883, above Snow's Marsh, and the very slight shoaling there found

appears to indicate that this and the other dredged channels will be able to take care of themselves in the future.

Other surveys were made from time to time during the year, and show favorable results almost everywhere, as follows: Federal Point, Caroline Shoals, and Zeke's Island, considerably increased in extent; "New Inlet," rapidly shoaling, and now almost landlocked; the "Swashes" continuing to close upon each other and upon the neighboring parts of Zeke's and Smith's islands, so as to strengthen themselves and almost landlock the new dike; Baldhead Point, somewhat eroded upon its sea front, but widened and extended upon its inner hook; Oak Island Point and Channel almost unchanged, while the Baldhead Channel has noticeably straightened, widened, and deepened, so as to show a practicable ship-channel of 250 feet minimum width, and of 15 feet least depth across its outer bar, of 14 feet least depth at mean low water across its inner bar, and of 15 feet least depth everywhere else in the main channel.

Preparations are being made to submit projects for obtaining a still greater depth of water in Baldhead Channel and for preserving the 16-foot river channels already dredged, by means of a certain small amount of submerged stone diking.

During the entire year this work has been carried on with great thoroughness, vigor, and economy under the immediate supervision of Assistant Engineer Henry Bacon, whose full report is appended.

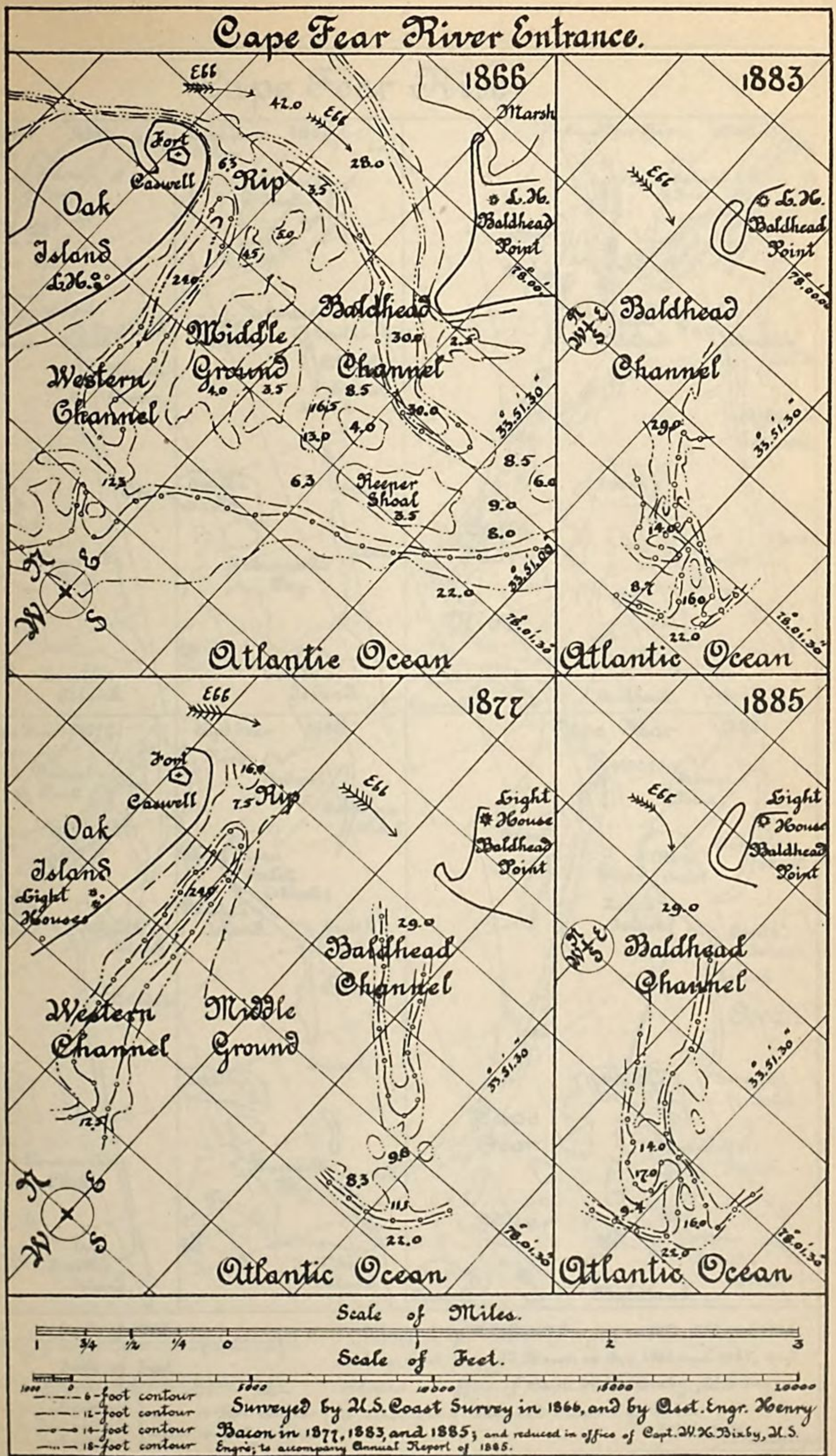
Recommendations for future work are as follows: That the above improvements, as originally projected in 1870 to 1882, be completed by completing the unfinished dike south of Zeke's Island, so as to thoroughly secure Smith's Island from further erosion by the ocean; by widening and deepening the existing river channels to their full dimensions of 270 feet width and 16 feet least depth at low water, and by further protecting them against subsequent deterioration by submerged stone dikes, where necessary, at a total expense of $380,000 in addition to the funds ($70,141.07) now available, the whole amount to be appropriated in one sum during the next year. It is further recommended that the present projects be further extended so as to deepen the bar entrance to at least 16 feet least depth at low water. The commerce of this harbor, now $18,000,000, as shown in the summary, is regarded as sufficient to justify an expenditure of several hundred thousand dollars for this purpose, and this amount should be appropriated in yearly installments of at least $300,000. Projects for this new work will be submitted during the coming year.

This river is in the collection district of Wilmington, N. C.

Money statement.

July 1, 1884, amount available		$29,397 10
Amount appropriated by act approved July 5, 1884		200,000 00
		229,397 10
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$139,749 92	
July 1, 1885, outstanding liabilities	19,506 11	
		159,256 03
July 1, 1885, amount available		70,141 07
Amount (estimated) required for completion of existing project		380,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		380,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

Cape Fear River Entrance.



Scale of Miles.

1 3/4 1/2 1/4 0 1 2 3

Scale of Feet.

1000 0 5000 10000 15000 20000

—·—·— 6-foot contour
—— — 12-foot contour
—o—o— 14-foot contour
—···— 18-foot contour

Surveyed by U.S. Coast Survey in 1866, and by Asst. Engr. Henry Bacon in 1877, 1883, and 1885; and reduced in office of Capt. W. H. Bixby, U.S. Engrs; to accompany Annual Report of 1885.

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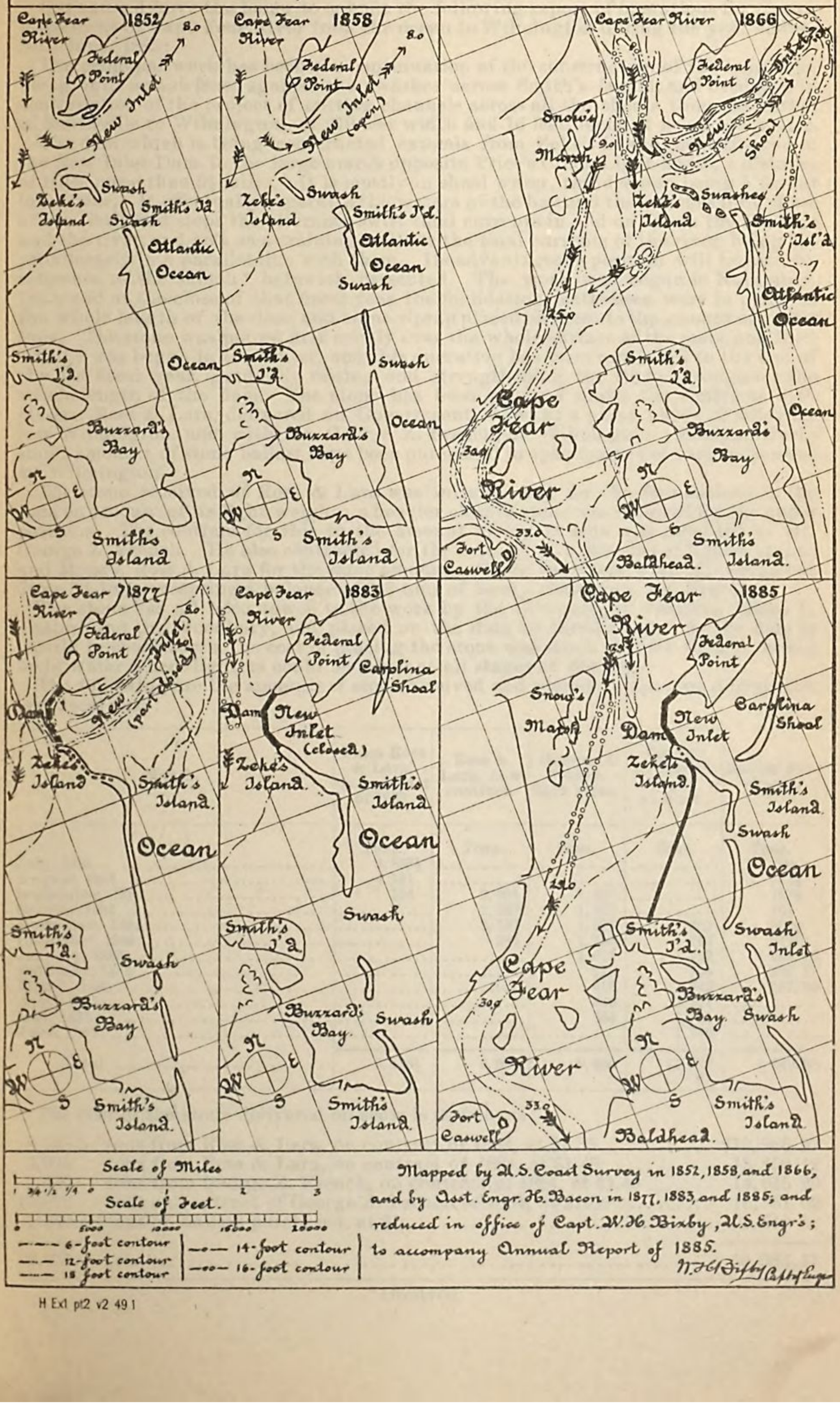
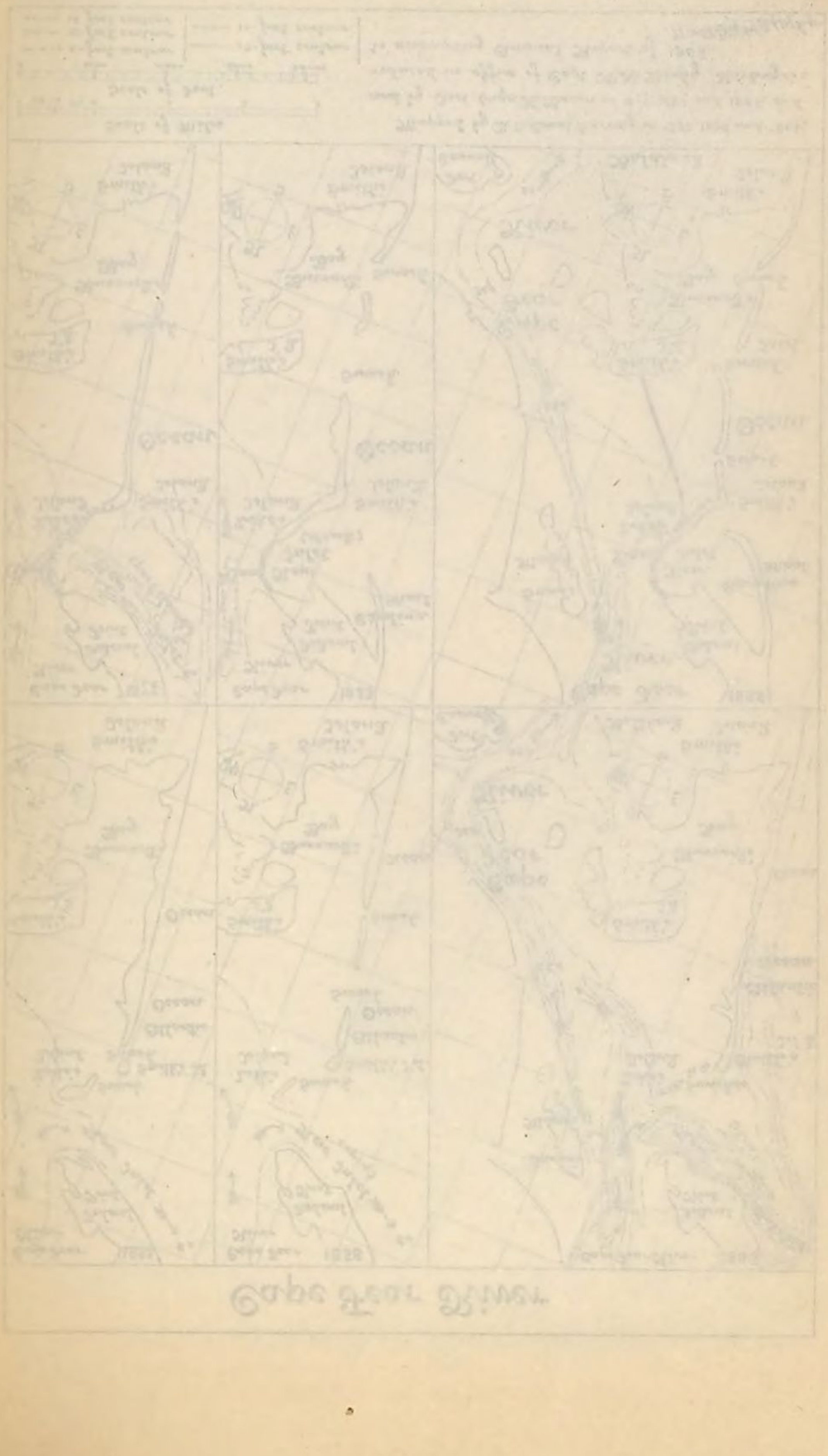
Cape Fear River



Mapped by U.S. Coast Survey in 1852, 1858, and 1866, and by Asst. Engr. H. Bacon in 1877, 1883, and 1885; and reduced in office of Capt. W.H. Bixby, U.S. Engr's; to accompany Annual Report of 1885.

W.H. Bixby Capt. of Engrs



REPORT OF MR. HENRY BACON, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Wilmington, N. C., July 21, 1885.

CAPTAIN: I have the honor to submit the following report of operations for the improvement of Cape Fear River from the ocean to Wilmington during the year ending 30th June, 1885:

The principal work has been the continuation of the construction of the long dam, being built as a defense against the swashes across Smith's Island, and dredging in continuation of the project of cutting channels across all the shoals from the harbor of Smithville to Wilmington, of 270 feet width and 16 feet depth at mean low water.

The dam which is being constructed extends from Zeke's Island, near the end of the New Inlet Dam, to the large marsh opposite Price's Creek Light-house, a distance of little more than 2⅛ miles. It is mostly in shoal water, the deepest being 5 feet at low water. It effectually separates the waters of the bay and the swashes from those of the river, and stops the alternate swift tidal currents in and out from the swashes and the river, and acts as a training-wall for the tidal currents of the river, being approximately in a parallel line with them. Its advantageous position will be seen by reference to the sketch* herewith presented. The work was begun in November, 1883, and at the close of that fiscal year the foundation mattresses were in place on the whole length of the dam, and stone riprap placed on them to the amount of 13,200 tons. The stone was placed first evenly over the whole surface of the mats, and then a ridge was begun in the center, and this operation has been continued to the end of the last fiscal year, gradually raising and strengthening the ridge throughout the whole length of the dam. The stone has been received under the contracts with Messrs. Ross & Lara, delivered on Government scows at a point about 12 miles below Wilmington, and with Mr. George Z. French, at Wilmington. Comparatively small amounts of stone ballast have been purchased in open market of various persons at Wilmington.

The stone received of Ross & Lara was suitable only for the foundations of the dam on account of its light weight; a heavier class of stone was required for the upper portions. The contract for this to the amount of 12,000 tons was awarded to Mr. George Z. French. He also contracted for the delivery of 9,000 tons of lighter stone; and Messrs. Ross & Lara for the same amount. These contracts were all completed June 30, 1885, excepting a balance of 638 tons of heavy stone from Mr. French.

The stone has all been towed to the work by the Government steamers James T. Easton and the Woodbury, and placed on the dam by hired labor. As the dam is mostly in shoal water, the cost of placing the stone was much greater than it would be in water where lighters could be taken at all stages of the tide.

The following are the amounts of stone received and placed on the dam during the last fiscal year:

Month.	From Ross & Lara, on contract of 1883.	Ross & Lara, new contract.	George Z. French, light stone.	George Z. French, heavy stone.	Ballast purchased.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*
July, 1884	3,883½	.....	.....	.....	80
August, 1884	4,131	.....	.....	.....	25½
September, 1884	124	2,991	1,008	.....	127¾
October, 1884	.....	2,522	1,967	.....	161
November, 1884	.....	2,597	1,233	653	322¾
December, 1884	.....	984	1,234	769	210¾
January, 1885	.....	.....	1,011	712	268.46
February, 1885	.....	.....	720	834	257.17
March, 1885	.....	.....	917	1,643	187.20
April, 1885	.....	.....	846	2,271	.....
May, 1885	.....	.....	554	2,221	.....
June, 1885	.....	.....	.....	1,769	.....
Total	8,138½	9,094	9,490	10,872	1,640.58

The cost of the stone delivered on scow is as follows:

8,138.5	tons from Ross & Lara, on contract of 1883, at $1.35	$10,986 97
9,094	tons from Ross & Lara, on contract of 1884, at $1.48	13,459 12
9,490	tons from George Z. French, on contract of 1884, at $1.48	14,045 20
10,872	tons on contract of George Z. French of 1884, at $1.55	16,851 60
1,640.58	tons of ballast purchased, at $1	1,640 58
39,235.08	tons	56,983 47

*Omitted.

The total expenditure on the dam for the year may be approximately estimated as follows:

Cost of stone on scow, as above	$56,983
Pay-rolls, including wages for supervision and repairs of steamers	19,753
Cost of provisions for subsistence	2,983
Repairs of machinery of steamboats	1,399
Fuel and oil for steamers and quarters	2,846
Two new scows	1,600
Total	85,564

This would make the cost of the stone in place on the dam $2.18 per ton of 2,240 pounds. The average cost of provisions for subsistence has been 22.04 cents per day per man, and includes the crews of the steamers.

Adding to the above $69,401, the estimated cost of the dam to July 1, 1884, makes the total cost to July 1, 1885, $154,965.

The dam is built up throughout its whole length to the ordinary level of spring tides, or 5.5 feet above mean low water. A beginning was made of finishing the top and slopes by carefully packing the stone to a smooth surface, bringing the top to the level above mentioned, and 7 feet width, with slopes of 1 foot vertically on 1.5 feet horizontally. About 570 feet in length was thus finished early in March, when it was necessary to suspend the operations, as there would not be funds available to finish the whole in that manner, and as it was essential to distribute the stone so as to protect, as well as practicable, the whole work.

During the progress of the work, as the weight of the structure was increased by the increased height, considerable subsidence has occurred. In several places there has been a subsistence of more than 1 foot after the full height and finish was made. The foundation is mostly on rather soft mud, sometimes overlaid by a thin structure of sand. Some sinking was anticipated, but more has occurred than was expected. The amount of stone required to finish the dam will exceed the estimates of 1883 and 1884, but will not be likely to exceed that of 1882, which was 78,000 cubic yards, considered equal to 78,000 tons. The stone already expended is 52,435 tons. The estimate for 78,000 yards was for stone placed directly on mud and sand.

One principal advantage of the mattress foundation is in the protection it gives at the margin each side of the dam against scouring from the overfall of the tidal currents, especially before the dam is built up to the full height. Scouring has thus been mostly prevented.

Notwithstanding the pliability of the mattresses, and the fact that the bottom fascine binders are longitudinal with the dam, the water found its way under the mattresses and caused a subsidence in many places where it could be definitely observed at low water. It is believed that the same thing has occurred in the deeper water, as the mattress foundation has settled in places without any particular depression toward the center, where the weight of the dam is. The experience of many years has convinced me that the foundation placed on sand or mud most secure from undermining by water is of small stone riprap. A good illustration of this is a street gutter, which is seldom, if ever, undermined by rapid currents of water.

In a soft foundation of comparative stiffness, riprap will settle more or less and finally secure the characteristics of a unified platform, and will support the limited weight required of it with perfect stability. In a foundation of sand, the limit of subsidence is soon reached and the water ceases to pass under the stone.

Whenever the mattresses are not covered with sand or mud, and are below half-tide, they are thoroughly eaten by the teredo worms. All kinds and sizes of wood are thoroughly perforated, down to three-sixteenths of an inch in diameter.

The effect of the construction of the dam on the swashes is apparent. The map * which will accompany the report will perhaps make a better exhibition than words or figures.

The following comparison of figures will show the progress toward a natural closure of the swashes:

Items.	Northerly swash.	Central swash.	Southerly swash.
Width at high water, June 30, 1884 ..... feet..	1,800	3,370	1,800
Width at high water, June 30, 1885 ..... do...	550	1,680	700
Decrease in width ..... per cent..	69	50	61
Width at low water, June 30, 1884 ..... feet..	1,700	2,400	1,400
Width at low water, June 30, 1885 ..... do...	150	1,200	350
Decrease ..... per cent..	91	50	75

* Omitted.

The total high-water width of the three swashes June 30, 1884, was 6,970 feet. The same June 30, 1885, was 2,930 feet, a decrease of 58 per cent. The total low-water width in June, 1884, was 5,500 feet; in June, 1885, 1,700 feet, a decrease of 69 per cent.

It must be remembered that the extensions of the beach, as well as the original ones, are low and narrow, and liable to be washed down by heavy storms, and the only security against permanent destruction is the new dam, and this, for want of further appropriations, must for the present be left in an unfinished state and liable to serious damage by the storms, so that the necessity for completing it thoroughly is apparent.

The northerly swash is much nearer the dam than the others, and would undoubtedly have widened and deepened but for the construction of the dam, which has caused its contraction and approximate closure.

At the close of the fiscal year of 1883–'84 the dredging had been finished to 270 feet in width and 16 feet depth, at mean low water, on all the shoals above the harbor of Smithville to a short distance above Orton Point, 12 miles below Wilmington. There had been a considerable deterioration in the upper reach of the Snow's Marsh Channel.

There were three remaining shoals to be dredged, known as the Lilliput Shoal, about 2 miles in length; the Big Island and Log Shoal, about 1.5 miles, and the Brunswick River Shoal, 1 mile, making a little more than 4.5 miles in length to be dredged over.

Proposals were opened August 28, 1884, for dredging through all the shoals a channel of 16 feet depth at mean low water, and of such width as the funds available would allow.

The contract was awarded to Mr. Rittenhouse Moore, of Mobile, Ala., who, after much delay in bringing his plant from Mobile, began work January 2, 1885. At the end of the fiscal year he had completed two cuts, each of 37 feet width, making 74 feet total width and 16 feet depth at mean low water, through all the shoals, and a beginning was made on the third cut at the Brunswick River Shoal. The work was all done, with the exception of 296 yards by the suction dredge, with one powerful grapple dredge, working night and day, stopping weekly only about thirty-two hours each Saturday afternoon and Sunday.

The dredged materials are being dumped near the western shore from the Lilliput Shoal, and near the eastern shore at the other shoals, where they are not liable to be carried into the channel by the current

The following are the amounts of work done in each month, the price of dredging being 14.5 cents per cubic yard, and for removing stumps and logs of trees of 12 inches diameter and upward, $40 each:

Date.	Cubic yards dredged.	Number of stumps.	Number of logs.
January, 1885	33,516	131	2
February, 1885	68,066	19	0
March, 1885	60,779	55	1
April, 1885	68,116	4	0
May, 1885	51,141	20	1
June, 1885	40,307	32	1
Total	321,925	261	5

Two stumps were taken from the Lilliput Shoal, and 32 stumps and 2 logs from the Brunswick River Shoal, and all the remainder from the Logs and Big Island Shoal. The cuts were made in the easterly side of the proposed channels at the Lilliput and Brunswick River shoals, and near the center at the Logs and Big Island Shoal, at the easterly side of the old dredged channel. One cut was mostly on the easterly bend of the old dredged channel, and on this most of the stumps above enumerated were found. They were unexpectedly easy to extract, being mostly pine stumps, with few roots, in place of cypress stumps which had been expected from the former reports. Many cypress stumps were afterwards found, especially at the Brunswick River Shoal, which were more troublesome. Almost all were extracted with the ordinary dredging bucket by first digging around them. Some four or five stumps were found which proved so difficult to extract that dynamite was placed on them, and they were blown in pieces; and in one case at least the stump was driven down bodily below the required level by the force of the explosion, the bottom being soft mud.

Thus far the price paid for stumps has been profitable to the contractor. It would probably be remunerative if all the stumps were of cypress trees. Many of the stumps are worn smooth, but the worn surfaces are not generally horizontal, but are highest

towards the center of the stump. They are of various degrees of soundness, the majority being considerably decayed, and all to some extent so. Only a few have been found worm-eaten. It is not easy to form an unassailable opinion as to how these stumps came to be where they are found. There are some indications, especially as to cypress stumps, that they grew at a higher level, and were gradually undermined and settled by the water passing under them. The process may be observed from year to year at the shores of the Cape Fear River. But when we find pine stumps with practically but a single long tap-root standing erect in sand, and 8 or 10 feet under water, the theory of undermining does not apply, and it would seem that the land must have gradually sunk after the growth of the trees.

The dredged channels through the shoals below those before mentioned have been well maintained excepting a slight deterioration, near the angle, in the Midnight Shoal Channel, and at the upper reach of the Snow's Marsh Channel, where there had been great deterioration at the beginning of the year. The possibility expressed in the last annual report that the shoaling might cease, has not been realized, the average decrease in depth (which was about 1 foot during the years 1883–'84) has been fully as great during the last year, and for a short distance only 12.5 feet depth at low water is available. It will require about 200,000 cubic yards of dredging, scow measurement, to restore the channel to 16 feet depth at mean low water. The source of this trouble is in the extreme softness of the adjacent material, and in the tidal currents which cross the channel with a slight angle. The filling is everywhere soft, there being no compact sand, as was found in the original cut.

The necessity for artificial work to preserve the channel, which was anticipated in the last report, is now apparent, and it is also thought that it should be done as quickly as practicable, as the middle ground between this channel and the old one is gradually wearing down, and any delay will increase the expense of the work.

It seems plain that the only certain method of preserving the channel is by a training-wall or dike on its easterly side, extending from the shoal water opposite the head of Snow's Marsh, to a point nearly a mile above where the tidal currents will be divided in lines approximately parallel. A longer dike is recommended than was suggested in the last annual report, in order to obtain more security from cross-currents at the head, which may be developed by shutting them off at the central portion of the dike.

On account of the destructiveness of the teredo worms it is not advisable to use wood in the construction of the dike, excepting in piles to be driven to give the exact lines for placing the stones, and for holding the lighters during the operation. The stone can be obtained from the quarries on the Cape Fear River, and especially from the Coquina quarry on the east side of the river about 12 miles below Wilmington, and about 8 miles from the work. This stone can be obtained and delivered at the work on Government scows at a cost not exceeding $2 per ton. It is of light weight but will answer very well for the purpose, and will make more bulk on account of its light weight, which averages about 128 pounds per cubic foot, or twice the weight of salt water. The price above named would command stone from other sources.

The following is the estimate for the dike or training-wall of 5,000 feet length and 5 feet top width, with slopes of 1½ on 1:

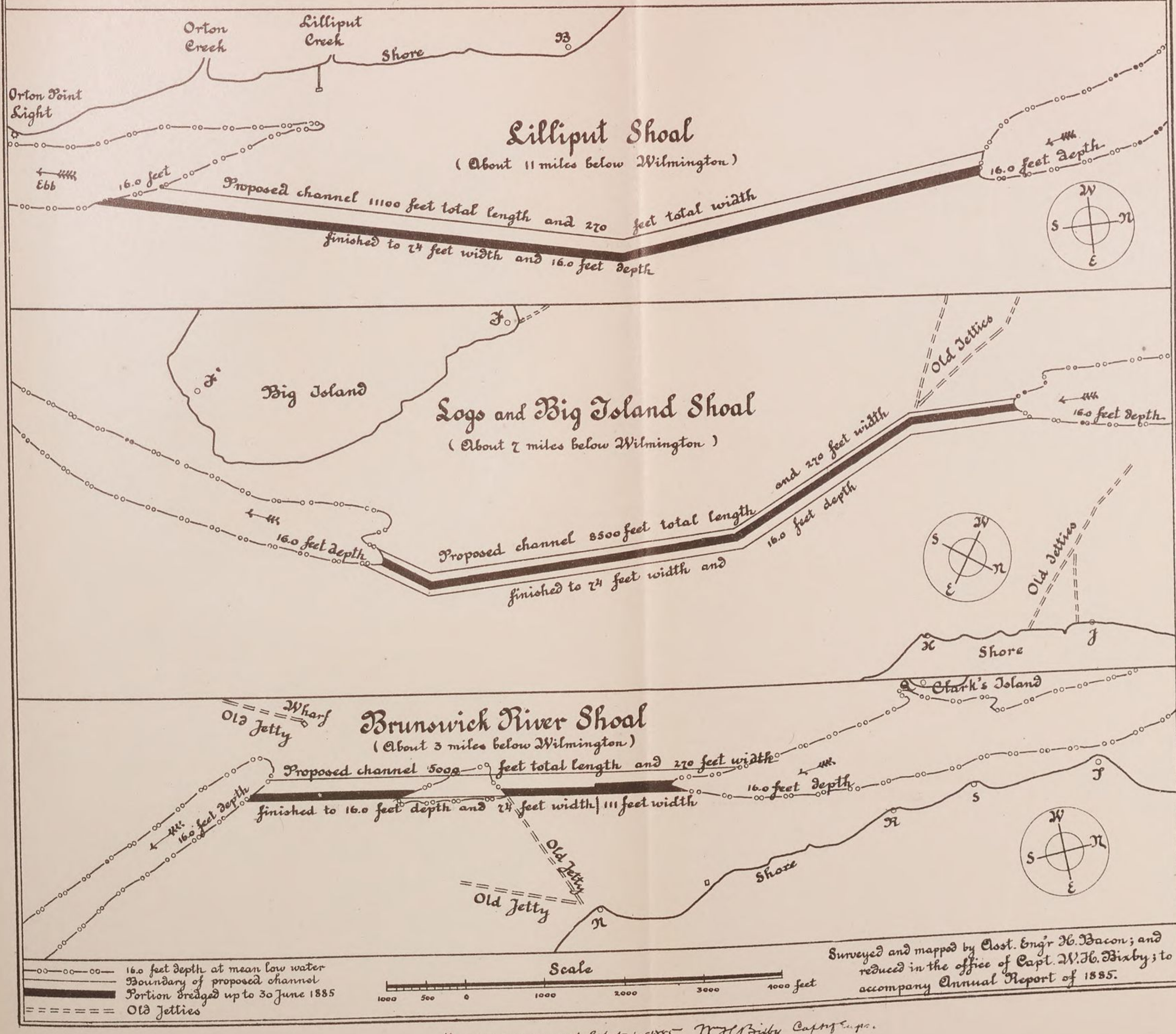
41,680 tons (2,240 pounds) stone rip rap at the work, at $2 per ton	$83,360 00
Labor placing the stone on the work, at 15 cents per ton	6,252 00
100 piles, driven, at $3	300 00
Total	89,912 00
Add 10 per cent. for superintendence	8,991 20
Total	98,903 20

While the work is in progress and before its completion, the channel should be restored by dredging to its original depth of 16 feet at low water. This work would be admirably suited for the use of a suction or pump dredge, which can discharge the material by a pipe over pontoons at the easterly side of the old channel at the Five Fathom Hole, a distance of about 1,500 feet.

Mr Moore has from the first expected to put in operation a suction or pump dredge which was contracted for, to be manufactured by the Novelty Iron Works in Dubuque, Iowa, such as has been in successful operation at Dubuque (H. C. Booth, patentee). After many delays the machinery arrived early in March, and was fitted up to work at the end of the month, and attempts to operate were made without success until the last of May, when it was laid up. The main difficulty seems to have been in the lack of something to cut up and stir the material at the mouth of the suction-pipe; jets of water were tried without success. The contractor is having machinery made to effect this object and expects to have the dredge in successful operation early in August, 1885.

The work done under the contract at the end of the fiscal year, which was the time

Annual Progress Map — Cape Fear River (below Wilmington) — 1884-1885.



To accompany annual Report for 1885 — W.H. Bixby Capt. Engrs.

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for its completion, amounted to $57,319.12. The contract time has been extended to October 31, 1885, and the amount of work limited to $108,000 in all for dredging and stump pulling.

The New Inlet Dam is in the same perfect condition as at the last annual report. The sand beach which has gradually extended over the site of the Caroline Shoals from a point northeasterly from the site of the Federal Point light-house, more than 2 miles, is now within 1,500 feet from the head of Smith's Island, thus nearly inclosing the New Inlet Basin and converting it into a sound.

The beach has increased in height and width during the year. The condition of this beach and the shore-lines of Federal Point and Zeke's Island and Smith's Island, as well as of the Swashes, is best shown in the sketch before referred to, which embraces all.

It is evident that the same natural causes which have formed the beach which inclose the New Inlet Basin, will tend to reform the beach at the Swashes and thoroughly close them, the former being the effect of the New Inlet Dam, and the latter of the new dam now under construction. In the latter case thorough closure will probably be made as the tide-water can pass through the inlets of the marsh to and from the mouth of the river.

The changes in the shore-lines of Baldhead Point will be indicated in a sketch to accompany the Annual Report. The *hook* of sand has widened and extended so as nearly to close on the mainland near the light-house. The small stone jetty constructed by the Light-House Department for the protection of the shore at the light-house has fully answered the purpose. Erosion has ceased and accretion begun.

There have been no marked changes in the shore-lines of Oak Island on the opposite side of the entrance.

Although there has been an extension at Baldhead Point, which has steadily progressed during the last fourteen years, the distance across the entrance to Oak Island has remained the same. Of late there has been a tendency towards the reformation of the beach of Baldhead Point extending towards the old jetty, which was built on the point in 1854 and 1855, and was flanked by the sea in 1871, and is now fully one-third of a mile from the shore.

A late survey of the Baldhead Channel, which was completed June 30, proves its condition to be quite as good as at the beginning of the year. The last soundings in the practicable ship-channel are 14 feet at mean low water, and from 250 to 300 feet is the least width. These are at what is known as the inner shoal and over a very short distance. Over all the remaining portions and over the crest of the bar fully 15 feet can be carried with a greater width. An examination of the chart shows that the straight deep-water pocket, which extends from Baldhead Point, and above, past the inner shoal, is at 15 feet depth at mean low water within 900 feet of the curve of the same depth at the sea. It would seem that with some artificial assistance to the forces of nature this channel could make its way through the intervening shoal, and this would make the entrance straight and more in line with the tidal currents, and would avoid the inner shoal. This assistance can be given by the suction dredge Woodbury, which was profitably employed in the channel from April, 1879, to October, 1881. An estimate for its operation is appended.

The question of here obtaining and maintaining 25 feet depth at low water is only one of dollars and cents and a proper dike system, and not one of practicability. The natural forces of the tidal currents in filling and emptying the great tidal reservoir at each tide can be relied on for the preservation of the channel between the jetties. The sheltered situation of the entrance from northerly and easterly winds adds greatly to the feasibility of improvements.

The deepening of Baldhead Channel and its vicinity has, as should be expected, caused a steady advance seaward of the crest of the bar and the 12 and 18 foot depths. This is shown by the numerous surveys made from 1877 to the present time in connection with this work.

A new boiler has been purchased and put in the steam-tug James T. Easton, and thorough repairs made to her hull and machinery, at a cost of about $4,000. Repairs have also been made to the boiler and machinery of the *Woodbury* to fit her for towing while the *Easton* was being repaired. Some further expenditure will be needed to fit her for dredging.

Two new scows have been constructed by the purchase of materials in open market and by hired labor. They are each 84 feet in length, 18 feet in width, and 5 feet in depth, and are of excellent materials and workmanship and of 100 tons burden each. The cost for both together was $1,614. Under an advertisement for bids, which were opened 22d October, 1884, the least for each scow was $945. The bids were rejected.

Careful hydrographic surveys have been made of the Baldwin Channel and vicinity, Snow's Marsh Channel (two surveys), the Midnight Shoal, and Brunswick River Shoal. Other surveys have been made in order to locate exactly the channels to be dredged and the marks for the same. Numerous piles have been driven and landmarks made for the ranges for dredging.

An elaborate survey of the beaches of Federal Point, Zeke's and Smith's islands, and the Swashes has been made by Mr. E. C. Tollinger, civil engineer and surveyor, under my direction, during June, 1885. His map of the same will accompany Annual Reports.*

Simultaneous tidal observations have been made during most of the working days of the year at Smithville, Wilmington, and at the Island Wharf near the new dam. Some of the results are shown below, and also a comparison with those of former years.

Summary of tidal observations for the year ending June 30, 1885.

Month.	Smithville.					Island Wharf.					Wilmington.				
	High-water.		Low-water.		Average range.	High-water.		Low-water.		Average range.	High-water.		Low-water.		Average range.
	Number of observation.	Average.	Number of observation.	Average.		Number of observation.	Average.	Number of observation.	Average.		Number of observation.	Average.	Number of observation.	Average.	
1884.															
July	27	5.32	27	0.90	4.42	27	5.28	27	1.37	3.91	23	5.55	23	3.00	2.55
August	26	5.38	26	0.98	4.40	26	5.30	26	1.46	3.84	26	5.61	26	2.91	2.70
September	26	5.77	25	1.24	4.53	26	5.61	26	1.78	3.83	24	5.68	25	2.87	2.81
October	26	5.72	23	1.25	4.47	27	5.58	27	1.76	3.82	22	5.45	22	2.56	2.89
November	24	5.20	24	1.53	3.67	25	5.20	24	1.53	3.67	24	5.27	20	2.27	3.00
December	24	5.09	25	0.78	4.31	24	5.01	24	1.25	3.76	24	5.20	18	2.39	2.81
1885.															
January	26	4.87	27	0.55	4.32	26	4.84	23	1.14	3.70	25	5.35	20	2.51	2.84
February	23	4.83	24	0.82	4.01	24	4.90	24	1.30	3.60	23	5.38	21	2.87	2.51
March	26	4.71	26	0.53	4.18	26	4.71	26	1.11	3.60	22	5.18	26	2.46	2.72
April	26	4.39	26	0.38	4.01	26	4.39	26	0.94	3.45	25	4.84	25	2.32	2.52
May	26	4.72	26	0.70	4.02	26	4.72	26	1.25	3.47	26	5.11	26	2.63	2.48
June	26	4.94	26	0.68	4.26	26	4.85	26	1.21	3.64	26	5.23	26	2.75	2.48
Average of the tide	306	5.09	....	0.81	.....	309	5.04	....	1.35	.....	290	5.32	....	2.64	.....
Average range	....	.....	428	.....	.....	....	.....	369	.....	.....	....	.....	268	.....	.....

The averages for the year are made up by dividing the sum of all the observations of the year of high or low water by the whole number of observations, and differ but slightly from the average of the months, when treated in like manner.

Comparison of results of tidal observation.

Place.	Smithville.						
Fiscal year.	1876–'77.	1879–'80.	1880–'81.	1881–'82.	1882–'83.	1883–'84.	1884–'85.
Average high water	4.88	5.01	5.10	5.04	4.97	4.96	5.09
Average low water	0.39	0.90	0.99	0.76	0.75	0.68	0.81
Average range	4.49	4.11	4.11	4.28	4.22	4.28	4.28

Place.	Island Wharf.		Wilmington.		
Fiscal year.	1883–'84, 8 months.	1884–'85.	1882–'83.	1883–'84.	1884–'85.
Average high water	4.87	5.04	5.39	5.31	5.32
Average low water	1.13	1.35	2.79	2.60	2.64
Average range	3.74	3.69	2.60	2.71	2.68

* Omitted.

The tide gauges are set nearly to the same level, but no instrumental levels have been taken. The level of mean low water is in all cases above the zero of the gauges. It has been assumed in all our hydrographic surveys that mean low water corresponds to 0.60 on the gauge at Smithville and 2.30 on the gauge at Wilmington.

The series of projects, which are now in the way of completion, began with the appropriation of 1870. The following are the appropriations made by Congress:

July 11, 1870	$100,000
March 3, 1871	75,000
June 10, 1872	100,000
March 3, 1873	100,000
June 23, 1874	150,000
March 3, 1875	150,000
August 14, 1876	132,500
June 18, 1878	160,000
March 3, 1879	100,000
June 14, 1880	70,000
March 3, 1881	140,000
August 2, 1882	225,000
July 5, 1884	200,000
Total	1,702,500

The present project embraces the completion of the dredged channels across all the shoals where dredging is required to make the depth 16 feet at mean low water to 270 feet in width; the repairs of the channels already dredged where there has been deterioration; the completion of the dam from Zeke's Island to the Big Marsh, which is under construction as a defense against the swashes, and the operation of the suction dredge Woodbury on the Baldhead Channel.

The following is the estimate of the amounts required to complete the present project, and also to construct the jetty necessary for the preservation of the upper reach of the Snow's Marsh Channel. The dredging is estimated at the present contract price. It is estimated that 998,000 cubic yards of dredging will be required to complete the channels across the three shoals, 200,000 yards at Snow's Marsh Channel, and 15,000 yards at the Midnight Shoal; total, 1,213,000 cubic yards.

ESTIMATE.

1,213,000 cubic yards of dredging, at 14.5 cents	$175,885 00
1,000 stumps and logs to be removed, at $40	40,000 00
Operations of suction dredge on Baldhead Bar twelve months, at $1,000 per month	12,000 00
22,000 tons of stone riprap for the dam, delivered at the work on Government scows, at $2	44,000 00
Labor, including placing the stone and facing the top and slopes, at 60 cents per ton	13,200 00
Cost of jetty at Snow's Marsh, as before stated	89,912 00
Total	374,997 00
Add 10 per cent. for office work and superintendence	37,997 70
Add 10 per cent. for contingencies	37,997 70
Total	450,992 40
Amount available July 1, 1885	70,141 07
Total	380,851 33

Mr. A. H. Van Bokkelen, president of the Chamber of Commerce of Wilmington, is preparing with much care a statement of the commercial statistics of the port, which he will forward to you.* He deserves great credit for the interest he has taken in the work and the public spirit he has for many years manifested.

I will forward with this a letter from Mr. C. H. Robinson, the collector of the port of Wilmington, in which he states the amount of revenue collected during the last fiscal year, and gives other valuable statistics.

The work is in the collection district of Wilmington, N. C. The nearest lighthouses are at Baldhead and Oak Island, at the mouth of the river.

Respectfully submitted.

HENRY BACON,
Assistant Engineer.

Capt. W. H. BIXBY,
Corps of Engineers, U. S. A.

*Appended.

COMMERCIAL STATISTICS.

WILMINGTON, *August* 2, 1885.

In response to your request I inclose you the following statistics:

EXPORTS.

Statement of steamships and sailing vessels over 60 *tons register, engaged in ocean commerce only, departing with full cargoes from the port of Wilmington, N. C., for twelve months ending June* 30, *for nine years*, 1870, 1873, 1878, 1880 *to* 1885, *inclusive.*

Years.	Destination.				Total.	
	Coastwise.		Foreign.			
	Number.	Tons.	Number.	Tons.	Number.	Tons.
1870	532	182, 032	40	8, 230	572	190, 262
1873	446	172, 527	144	40, 856	590	213, 383
1878	252	114, 539	308	95, 921	560	210, 460
1880	272	122, 340	316	96, 968	589	219, 308
1881	282	126, 642	302	100, 840	584	227, 482
1882	334	149, 368	267	88, 000	601	237, 638
1883	288	133, 272	246	83, 848	534	216, 920
1884	293	134, 355	228	78, 129	521	212, 464
1885	268	119, 117	230	89, 552	498	208, 669

Shipments from port of Wilmington, N. C., by ocean carriage, of the principal articles of export, foreign and coastwise, for twelve months ending June 30, *for eight years* (1870, 1873, 1880 *to* 1885, *inclusive*).

Years.	Cotton.			Sawed lumber.		
	Foreign.	Coastwise.	Total.	Foreign.	Coastwise.	Total.
	Bales.	*Bales.*	*Bales.*	*Feet.*	*Feet.*	*Feet.*
1870	20	44, 919	44, 939	8, 378, 861	11, 515, 123	19, 893, 981
1873	11, 927	52, 635	63, 562	4, 231, 030	2, 998, 295	7, 229, 325
1880	36, 586	40, 220	76, 806	9, 313, 310	21, 152, 583	30, 465, 893
1881	70, 483	47, 705	118, 188	17, 580, 000	26, 320, 000	43, 400, 000
1882	62, 833	74, 253	138, 086	12, 721, 000	34, 718, 226	47, 439, 226
1883	55, 579	72, 615	128, 194	9, 691, 000	21, 945, 265	31, 636, 265
1884	47, 242	49, 315	96, 537	11, 497, 000	24, 847, 370	36, 345, 370
1885	65, 862	33, 946	98, 837	14, 912, 000	23, 762, 500	38, 674, 500

Years.	Shingles.			Spirits turpentine.		
	Foreign.	Coastwise.	Total.	Foreign.	Coastwise.	Total.
	Number.	*Number.*	*Number*	*Casks and cases.*	*Casks and cases.*	*Casks and cases.*
1870	2, 339, 334	4, 804, 890	7, 144, 224	32, 889	68, 966	101, 855
1873	3, 057, 805	5, 443, 408	8, 501, 213	83, 129	42, 708	125, 837
1880	3, 568, 800	4, 132, 500	7, 701, 300	77, 651	29, 378	107, 029
1881	3, 820, 500	4, 561, 500	8, 382, 000	51, 894	30, 382	82, 276
1882	3, 034, 000	4, 033, 000	7, 067, 000	58, 464	29, 374	87, 838
1883	2, 308, 000	3, 394, 000	5, 702, 000	56, 762	35, 545	92, 307
1884	3, 433, 000	5, 831, 500	9, 264, 500	53, 022	28, 638	81, 737
1885	3, 297, 000	6, 447, 500	9, 744, 500	48, 468	18, 896	67, 364

Shipments from port of Wilmington, N. C., by ocean carriage, &c.—Continued.

Years.	Crude turpentine and pitch.			Rosin.			Tar.		
	Foreign.	Coast-wise.	Total.	Foreign.	Coast-wise.	Total.	Foreign.	Coast-wise.	Total.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Bbls. and cases.*	*Bbls. and cases.*	*Bbls. and cases.*
1870	3,448	17,553	21,001	59,563	483,546	543,109	6,107	54,090	60,197
1873	817	22,261	23,077	248,424	307,758	556,182	20,799	47,820	68,619
1880	265	12,968	13,233	452,226	37,756	489,982	11,428	45,502	56,930
1881	162	12,577	12,739	438,750	48,480	487,230	14,547	49,113	63,660
1882	111	8,855	8,966	347,504	87,288	434,892	14,287	53,722	68,594
1883	882	10,480	11,362	380,099	70,459	450,558	26,905	57,176	84,075
1884	1,209	51,849	53,058	332,913	55,549	388,462	24,600	69,128	93,728
1885	995	48,583	49,578	290,165	25,914	316,079	26,072	63,644	89,716

EXPORTS AND IMPORTS.

Value of exports and imports, both foreign and coastwise, for twelve months ending June 30, for eight years (1870, 1873, 1880 *to* 1885, *inclusive*).

Year.	Exports.	Imports.	Totals.
1870	$7,864,500	$5,500,000	$13,364,500
1873	8,780,300	5,000,000	23,780,300
1880	10,286,600	7,000,000	17,286,600
1881	12,503,250	8,500,000	21,003,250
1882	13,970,000	7,000,000	20,970,000
1883	12,678,913	6,500,000	19,178,913
1884	10,530,562	7,500,000	18,030,562
1885	10,492,680	7,000,000	17,492,680

Respectfully,

A. H. VAN BOKKELEN,
President Chamber of Commerce, Wilmington, N. C.

HENRY BACON, Esq.,
Assistan Engineer.

LETTER OF COLLECTOR OF CUSTOMS AT WILMINGTON, NORTH CAROLINA.

CUSTOM-HOUSE,
Wilmington, N. C., July 12, 1885.

In response to your verbal request, I give the record below of the transactions of this office for the year ending June 30, 1885:

Receipts:	
Duties	$22,001 07
Tonnage	2,337 48
All other	3,715 01
Total	28,053 56
Exports:	
Domestic	4,425,312 00
Foreign	21 00
Total	4,425,333 00
Imports and warehouse entries	74 00
Entries, foreign	156
Clearances, foreign	230

Entries, coastwise	116
Entries, cleared	63
Vessels documented	81
Tons	9,158.38

Respectfully,

C. H. ROBINSON,
Collector.

HENRY BACON, Esq.,
Assistant Engineer.

M 9.

IMPROVEMENT OF GREAT PEE DEE RIVER, SOUTH CAROLINA.

The amount appropriated by act July 5, 1884, together with the funds then available, was too small for economical work, but improvement was so much needed that small immediate actual results were regarded as more valuable than larger but delayed possible ones.

Owing to its experimental nature, its variable features, and the difficulty of properly specifying it beforehand and inspecting it afterwards, the work was allowably done by hired labor and the purchase of materials in open market.

The special work of the year was as follows:

Between October 7, 1884, and May 30, 1885, this river was moderately well cleared of its sunken and overhanging obstructions over the 41 miles heretofore most dangerous, from Point Harrelson, 14 miles above its mouth, to Little Bluff, 129 miles above its mouth, and it was also roughly cleared of similar obstructions from Little Bluff, 94 miles farther, to Cheraw, the head of river navigation, 223 miles from its mouth. In this way, from these 209 miles of river, 452 large logs from 1 to 5 feet in diameter and 20 to 90 feet in length, 152 stumps, 35 cords of snags, and 1 barrel of rosin were removed from the bed of the channel, and 972 trees and 840 linear feet of brush were cleared from the banks of the river where they overhung and impeded navigation.

Water-gauges were established at convenient intervals of from 2 to 5 miles, and their low-water readings were noted.

During the past year this work has been carried on with great vigor and thoroughness by Assistant Engineer Reid Whitford, whose full report is appended.

The navigation of this river is obstructed at points, as shown by the following extract from special report, dated January 17, 1885:

> About 125 miles above Georgetown this river is crossed by the Wilmington, Columbia and Augusta Railroad, on a bridge provided with a draw-span of suitable width. Projecting iron work on the piers, swift cross-currents in the river, and an improperly arranged piling fender combine to subject passing vessels to injury.
>
> Several miles above the railroad bridge the river is also crossed by the toll-bridge of the Society Hill Bridge Company on a through bridge provided with a draw-span of proper width. Swift and strong cross-currents, and the absence of suitable fenders, combine to subject passing vessels to injury by the bridge piers.
>
> I recommend that the owners of both these bridges be required to provide strong and suitable fenders at both ends of these draw-openings, these fenders extending 100 feet above and below the bridge, and rising above ordinary high water to within about a foot of the draw-span's lower chord.

Recommendations for future work are as follows: That this improvement be completed in accordance with the present approved and adopted project, so as to secure a thoroughly cleared 9-foot navigation 41 miles upward to Smith's Mills, and thence a 3.5-foot navigation 182 miles far-

ther to Cheraw, at all stages of water, at a total expense of $90,000 in addition to the funds ($909.59) now on hand, this amount to be appropriated in two yearly installments of $60,000 and $30,000, respectively. Further improvement, so as to extend the navigation above Cheraw, or so as to increase the depth below Cheraw, is not recommended.

This river is in the collection district of Georgetown, S. C.

Money statement.

July 1, 1884, amount available		$154 53
Amount appropriated by act approved July 5, 1884		8,000 00
		8,154 53
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$7,212 19	
July 1, 1885, outstanding liabilities	32 75	
		7,244 94
July 1, 1885, amount available		909 59
Amount (estimated) required for completion of existing project		90,909 59
Amount that can be profitably expended in fiscal year ending June 30, 1887		60,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

REPORT OF MR. REID WHITFORD, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE.
Georgetown, S. C., June 5, 1885.

CAPTAIN: I have the honor to make the report that follows upon Great Pee Dee River improvement during fiscal year to date.

By agreement Mr. H. S. Cordes furnished a self-propelling steam hoister, and with it work was begun on 7th October last, at the village of Port Harrelson, about 40 miles above Georgetown, and continued upwards to a point about 160 miles above Georgetown, at which place, "Tiger Head," this hoister ceased operations on October 30, and proceeded thence direct to the Wateree River, where she was afterwards employed in removing obstructions.

Early in November a hand hoister, belonging to the United States, was converted into a very serviceable steam hoister. Having been towed to Dick Nalum's Landing, about 133 miles above Georgetown, work was then, November 15, begun by this machine and continued downward, working over roughly the entire length of the river below, and was finally laid up for the season on April 30. By agreement Messrs. Skinner & Ferris furnished for this work a first-class, thoroughly equipped, self-propelling steam hoister and pile-driver combined, including a high-pressure force-pump of considerable power. This machine began work at Cheraw, head of navigation, and, having worked over the entire length of the river to Georgetown, was finally laid up for the season May 30, the appropriation having been exhausted.

When it is remembered that the distance to be worked over on this river is about 200 miles, the amount of money allowed for it, about $8,000, and the vast quantities of logs and snags obstructing the channel, after the accumulation of ages, it could not be reasonably expected that any space of the river could be thoroughly cleared of logs except to the exclusion of work on the other portions of it.

In order that the expenditure of the money might be distributed over the entire distance, so that as much immediate good as possible might be done, the selection of the initial points of work of the hoisters was made with the view that the entire river, from its mouth to Cheraw, might be at least roughly worked over once before the final suspension of operations for the season.

For the above reason the hoisters were confined to the removal of such obstructions only as most particularly interfered with present navigation of the stream, and the cutting of such overhanging trees as would most likely immediately fall and block up the channel, or which by leaning far over damage the upper works of passing steamers. Consequently there remains a great quantity of like character of work to be done in the future over the same track before the channel is approximately thoroughly cleared.

During the season just ended, this amount of work was accomplished: Removed from the river 452 large logs, 152 large stumps, 35 cords snags, one barrel rosin. From

the banks: 972 overhanging trees, 840 linear feet of banks trimmed of small growth.

When removal of logs was stopped by high water, the force was put at cutting overhanging trees. The work was thus enabled to go on continuously with very little, if any, suspension. Since the commencement of the improvement, work has been carried on at intervals for past three or four years.

As well as could be learned, the following statement shows about what stretches were worked over:

No.	Name of place.	Distance from Georgetown.	Stretches worked over, October, 1884, to June, 1885.
		Miles.	
1	Georgetown	0	
.....	Mouth of river	26	
11	Port Harrelson	40	1883?
19	Smith's Mill	67	
52	Little Bluff	155	1881?
53	Pocket	162	
55	Red Bluff	167	1882?
57	Whipple	174	
60	Hodges	182	
65	Hennagens	212.5	1883?
81	Cheraw	250	

NOTE.—The distances given are uncertain, being taken from the estimated speed of boats. They are subject to change as the river may be measured in continuing the improvement.

As is the case with other streams of same character, a yearly expenditure of a small amount will be needed to keep the channels free from logs after the present project is completed.

The banks, which are covered with a growth of heavy timber, are in very many places eroding and caving under the action of the currents at high water, throwing large trees yearly into the river. It is thought the cutting away of the growth at such places, and protecting the banks from future wash by proper dikes, is a matter which should be considered in the future improvement of this river. Many dangerous snags would thus be kept yearly from falling in. I would recommend a continuation of the same description of work as heretofore till completion of present project. The depth desired is about 9 feet at dead-low water, to Smith's Mills, approximately 67 miles from Georgetown, and 3.5 feet at same stage of water from former place to Cheraw, approximately 183 miles from Smith's Mills. Looking to this end, an account was taken of the logs and snags left to be removed; also the approximate number of miles of caving banks to be trimmed. Necessarily the account is not positively exact, because of the difficulty of arriving at the number of logs to be taken out when they are found in layers, as is frequently the case. There may prove to be more to be removed, hardly a less number, than will be given. Where the lengths of the stretches of the banks to be cleared are determined by eye measurement, as is the case in this instance, the total summing up of the distances is too uncertain; there may be somewhat more or less—hardly less. No estimate will be made for diking thought to be needed as a protection against future erosion of banks, because a survey will probably have to be made to determine their height and the style best adapted for the purpose before reliable figures on the subject could be submitted. There are some sandbars between Georgetown and Smith's Mills upon which there is not 9 feet at dead low water, and some between that place and Cheraw with less than 3.5 feet at same stage of water. A survey will be necessary to fix their exact location and extent, and from which to collect facts relating to them upon which could be based estimates for their improvement.

The following estimate is respectfully submitted of the probable cost of completing the existing project of clearing the entire river of obstructions for channel-way about 80 feet in width, and cutting from the eroding banks timber which may soon fall:

6,000 logs and stumps, at $8 each	$48,000
50 miles of caving banks from which to remove the growth, about 250 large trees, at $1, and 1,000 small trees at 10 cents, at $3.50 per mile	17,500
12 sunken wrecks, at $200 each	2,400
Total	67,900
General and local superintendence, per year, 10 per cent	6,790
Contingencies, 10 per cent	6,790
Total	81,480

In addition I should say about from $5,000 to $6,000 will be needed annually to pay a hoisting machine to keep the stream clear of snags after the above work is completed.

The Pee Dee is well worthy of this expenditure to furnish better navigation and open it up to a very large trade, which would become established could the improvement be effected, allowing the boats to run with regularity and dispatch, which they are now unable to do.

This important stream traverses the entire length of South Carolina from north to south. It drains an immense area of country in the richest area of the State. Comparatively there has been very little money expended on its improvement.

The very fact that immense quantities of freights would seek an outlet by this highway induces me to recommend strongly its further and thoroughly improvement, especially since the greater portion of the desired improvement consists simply in removing logs and overhanging trees. It is believed that their thorough removal would alone materially increase the commerce at once. The Black, Little Pee Dee, and Lynch's rivers, besides Black Creek, are prominent tributaries to the Great Pee Dee. Considerable traffic is carried on in pole-boats and rafts over these at high water, and, in addition, two steamers are run regularly on Black River. They are, I am informed, likewise badly choked with fallen timber, which greatly interferes with their free use.

The following commercial statistics for the year now ending have been gathered from the most reliable sources:

Articles.	Quantity.	Value.
OUTWARD FREIGHTS.		
Cotton.....bales..	8,857	$442,850
Spirits turpentine.....barrels..	5,108	76,620
Rosin.....do...	27,207	54,414
Crude turpentine.....do....	2,000	4,000
Rough rice.....bushels..	100,000	125,000
Wine.....barrels..	68	3,400
Cotton seed.....sacks..	1,235	945
Lumber.....feet..	3,000,000	50,000
Shingles.....number..	3,000,000	15,000
Ton timber.....sticks..	6,000	24,000
Total.....	.....	796,229
INWARD FREIGHTS.		
General merchandise, such as hay, salt, lime, &c.....tons..	10,338	520,000

The commerce has been carried on by about thirty sail of sea-going vessels, having a carrying capacity each of about 500 tons, from Smith's Mill down, and a line of three steamers, having a carrying capacity each of about 1,000 bales cotton, from Cheraw down. Besides these, there are a great number of pole-boats and rafts, conducting a traffic which amounts to considerable in the course of a year. No account could be gotten as to their number or quantities of freights transported by them. Neither could there be any statement obtained of amounts of freights transported over the Great Pee Dee which go to and come from its tributaries. This is no small item, though, in connection with its commerce. The commerce stated in figures above is far below the yearly average for this river. The falling off in lumber freights has been due to the little demand and corresponding low prices, which caused mills to suspend work for a portion of the year. The decrease in other freights was owing to the unusually low stage of the water, which continued late into the winter, past the busiest time in the cotton season. This prevented steamers from running only as high up as the crossing of the railroad bridge, which is about 100 miles below Cheraw.

There is generally a great deal more commerce on the river between Cheraw and this bridge than between the bridge and Georgetown. I do not doubt but that if the boats could have run uninterruptedly, with a draught of about 3.5 feet, to Cheraw during the year past they would have brought down at least from 35,000 to 40,000 bales of cotton, and would have carried up at least $1,000,000 worth of general merchandise.

In a great measure the logs filling the channels, upon which, in innumerable instances, there is not a depth of 3.5 or even 3 feet over them at dead low water, caused this trouble and loss to the boats. Hence the necessity for their thorough and soon removal.

The first bridge over this river is owned by the Wilmington, Columbia and Augusta Railroad. It is a Howe truss through bridge, with stone abutments and piers of iron

cylinders. The top of rail is 31.85 feet above dead low water. It is furnished with suitable draw opening, but dikes or approaches should be constructed to protect passing boats. I respectfully send you herewith a sheet* showing the profile of the rise and fall of the water at the bridge. This is taken from observations which we have had made during past several months.

The next bridge is a toll through bridge for vehicles over the river at Society Hill, with wooden piers and abutments. It is provided with a proper draw opening, but approaches or dikes should be constructed also at this draw to protect passing boats. The top of floor of bridge is 47.5 feet above dead low water.

The next bridge is at Cheraw, above the limit to navigation. The bottom of the bridge is 37.6 feet above dead low water. During the dead low water period of last fall sixty water-gauges were fixed at convenient intervals between Cheraw and Georgetown, thus permanently securing that level of water.

A communication from Mr. H. S. Cordes, general manager of South Carolina Steamboat Company, is forwarded with this. It explains itself. Work has been done by hired labor and machinery, and material purchased in open market.

In connection with this work, I wish to add that Mr. Thomas S. Daggett, overseer, has faithfully and efficiently performed his duties thereon.

Very respectfully, your obedient servant,

REID WHITFORD,
Assistant Engineer.

Capt. W. H. BIXBY,
Corps of Engineers.

LETTER OF THE GENERAL MANAGER OF THE SOUTH CAROLINA STEAMBOAT COMPANY.

CHARLESTON, S. C., *June* 1, 1885.

DEAR SIR: In reply to your inquiry as to whether there was an average amount of freight transported over the Great Pee Dee River during the past year by our boats, I have to say that there was not, the amount being far below the average, and this was due to the extremely low water, continuing till late in December, which prevented our boats from running up further than the Wilmington, Columbia and Augusta Railroad bridge. Unfortunately the low water covered the busiest period of the cotton season, when there are naturally more freights to be transported each way. As you will know, we have three first-class side-wheel boats, built expressly for this river. They will carry about 1,000 bales of cotton each. We are thus prepared to handle quickly and cheaply large quantities of freights whenever our boats can run. Knowing the resources of the Pee Dee country thoroughly; having been connected with transportation lines over that river for the past eighteen years, I think I would be safe in saying that could our boats have found a depth of not less than 3.5 feet water during the busy season just past, from Georgetown to Cheraw, we would have brought down at least from 35,000 to 40,000 bales of cotton, and would have carried up from 30,000 to 40,000 tons of general merchandise.

The work of removing obstructions, recently done by the United States Government, has been of great benefit to our boats, but there is very much left to be done of the same character of work, which, if thoroughly done, will be of incalculable convenience and safety to our boats, in allowing us to run longer and further up at low water. It is very much regretted by our company that this work cannot go steadily on, so that the river might be so improved that our boats could run at night. There are some sand-shoals with less than the depth we want between railroad bridge and Cheraw, but doubtless some of these would disappear soon as logs were removed, which seem to bank up the sand.

I hope to see the work on the Pee Dee River carried to an early completion.

Very respectfully, yours,

H. S. CORDES,
General Manager South Carolina Steamboat Company.

Mr. REID WHITFORD,
Assistant Engineer.

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* Omitted.

M 10.

IMPROVEMENT OF WACCAMAW RIVER, SOUTH CAROLINA.

The amount appropriated by act July 5, 1884, together with the funds then available, was too small for economical work, but improvement was so much needed that small immediate actual results were regarded as more valuable than larger but delayed possible ones.

Owing to its experimental nature, its variable features, and the difficulty of properly specifying it beforehand and inspecting it afterward, the work was allowably done by hired labor and the purchase of materials in open market.

The special work of the year was as follows:

Between September 22, 1884, and April 7, 1885, the river, from its mouth 66 miles up to Conwayborough, was thoroughly cleared of all its sunken and overhanging obstructions. In this way 797 sunken logs, 100 stumps, 35 large trees, with their roots, 17 cords of small snags, 9 barrels rosin, 3 sticks of timber, 1 large flat-boat, and 1 small schooner were dug out and removed from the bed of the channel; and 591 large trees, with their roots, 1,061 small trees, the branches of 112 other trees, 99 protruding stumps, and about 14,550 linear feet of brush were cleared from the banks of the river where they overhung and impeded navigation. Besides this, 15 cords of felled trees and brush and 131 cubic yards of roots and earth were removed from a cut-off at Little Needle's Eye, and repairs were commenced at Oat Bed Shoal.

During the same interval of time careful surveys were made to determine the condition of all shoals where jetties had formerly been constructed or started, and also of all shoals and sharp bends where improvement appeared specially desirable. At all places where jetties had been completed they appear to have done some good, as the boats experience less trouble to-day in passing these localities; but for the want of adequate funds, and other reasons, half of these jetties were left unfinished, and the other half were only imperfectly and hurriedly finished. The present maps are sufficient for the construction of careful projects everywhere, and the required depth is now easily obtainable if the necessary funds be appropriated therefor.

Water-gauges were established at convenient intervals of from 1 to 2 miles, and their low-water readings were noted.

During the past year this work has been carried on with great vigor and thoroughness under the immediate supervision of Assistant Engineer R. Whitford, whose full report is appended.

Recommendations for future work are as follows: That this improvement be completed in accordance with the present approved and adopted project so far as at present to secure a channel 12 feet deep at mean low water, with 80 feet bottom width, through the mouth of the river 41 miles up to Bucksville, and thence a channel 10 feet deep at mean low water, with 80 feet bottom width, 25 miles farther to Conwayborough; thence a thoroughly cleared 3-foot navigation 24 miles further to Reeves Ferry throughout the entire year; and thence a thoroughly cleared natural channel 54 miles further to Lake Waccamaw, at a total expense of $103,000, in addition to the funds ($36.19) now available, to be appropriated in two yearly installments of $63,000 and $40,000, respectively. Further improvement in accord with the original project, so as to secure a 12-foot navigation at all stages of water from Bucksville 25 miles to Conwayborough, is not recommended at present.

This river is in the collection district of Georgetown, S. C.

Money statement.

July 1, 1884, amount available	$330 82
Amount appropriated by act approved July 5, 1884	6,000 00
	6,330 82
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	6,294 63
July 1, 1885, amount available	36 19
Amount (estimated) required for completion of existing project	103,036 19
Amount that can be profitably expended in fiscal year ending June 30, 1887	63,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

REPORT OF MR. REID WHITFORD, ASSISTANT ENGINEER.

GEORGETOWN, S. C., *May* 23, 1885.

CAPTAIN: I have the honor to submit the following report upon Waccamaw River improvement for fiscal year to date. So much has been written in former reports concerning the geographical position of this river that it is thought unnecessary to repeat the same here.

As you will know, the Waccamaw is a deep, dark, sluggish stream, and is bordered by fertile farming lands, and a variety of valuable timber covering immense areas. So far as ascertained there are no obstructions interfering with present navigation from Georgetown to the mouth of Bull Creek, or probably more properly the mouth of the Great Pee Dee River.

There is a sufficient depth of water and width of channel over this entire distance to accommodate the largest vessel which can cross the bar at the entrance to Winyaw Bay, and therefore the improvement has been confined to the interval between the mouth of said creek, approximately 26 miles from Georgetown, and the town of Conway, approximately 63 miles from Georgetown.

Early in September, by agreement, Mr. Thomas W. Daggett furnished a combined steam hoister and pile driver, properly manned and thoroughly equipped, a part of the equipment being a steam saw and a high-pressure strong force-pump, with necessary rubber hose, nozzles, leading pipe, &c.

Operations began at Conway regularly September 22, 1884, and were continued with very little interruption, under the existing project, between points mentioned above, and finally ended for the year on April 7, the small appropriations having been exhausted. Covering this period the following work was done:

Removed from the channel—	
Logs, large and small, mostly large	797
Barrels rosin	9
Sticks ton timber	3
Lighter flat, 12 by 45 feet, 4 feet deep	1
Large trees with roots and clinging earth	35
Stumps of trees, large and small	100
Cords of smaller obstructions, snags, &c	17

And a large portion of a small sunken schooner.

From the river banks—	
Overhanging trees, mostly large, removed with roots	591
Overhanging trees removed by cutting	1,061
Overhanging trees trimmed	112
Protruding stumps removed with roots	99
(Approximately) running feet of banks cleared of brush, &c	14,550
Cords of felled timber and brush burned	15
Cubic yards surface earth and roots removed from "Little Needle Eye" Cut-off	131

The repairs of Oat Bed Shoal jetty were partially completed. This consisted in driving in permanent position 27 piles, from 12 to 14 inches square, to a depth of 13 to 14.5 feet in bottom, framing in their tops, and fastening under low-water line the necessary cap and mud-sills, collecting and storing the remainder of the material for its entire completion.

Every effort was made to clear the channel thoroughly of obstructions, and with this in view the total distance was worked over a number of times and a diligent

search for logs made on the bottom with drag-hooks. Though a recent trip of inspection over the river enables it to be said that there is not a snag or log to be seen in the channel, and apparently the banks are free from overhanging trees with an occasional stretch of the shore trimmed of brush, still this character of work cannot be said to be permanently finished, because there are numerous logs underlying the sand deposits, which become exposed and obstruct the channel as the sand shifts. At some points the constant washing and undermining of the low banks will cause other trees to lean forward. Past reports have stated that at certain "points the river had been thoroughly cleared of logs," and no doubt was, so far as those above the bottom were concerned, but at the same places other logs were found and removed in this year, the sand having washed away and exposed them. Further on in this report an amount will be recommended to be expended in this description of work during the coming year. No fixed number of logs and trees will or can be mentioned as likely requiring removal, but simply an amount stated which will be thought sufficient to dispose of all for that time. It may not be amiss to here remark that the force-pump was used with decided success and dispatch as an aid to the hoister in removing trees with roots and logs where one end was deeply embedded in the bottom. Strong jets of water were forced through nozzles at about the place wished to be operated upon, and very soon the earth would be "loosened up" so as to permit the hoister to remove with ease what before could not be dislodged. This method to a reasonable extent was an economical substitute for blasting with explosives.

Little Needles Eye Cut-off (see Sheet D),* heretofore alluded to, is an abrupt bend about 1.75 miles below Conway, forming a narrow neck of land.

A line drawn across the least width of this neck fell at a point where there existed a ditch about 8 feet wide and 4 feet deep, which had at some time in the past been excavated, and corresponded well with the general direction of the river, both above and below. Though the distance to be saved around the Needle Eye by the cut-off is not much, still the bend is exceedingly difficult to made by boats running on the river, and it was filled with logs (most of the logs since removed). For this reason the cut-off was attempted by widening to 50 feet in the clear and deepening the ditch. The proposed width of the new cut was cleared of timber, brush, and roots. The surface earth, to a depth of 0.5 foot below low water, was carried away, and the work was left thus unfinished to allow the winter floods to do what scouring it might to aid in producing the desired depth. An examination since shows the cut to be pretty well filled with formidable cypress stumps and large roots, which prevented any satisfactory deepening by the natural flow of the current.

Boats of light draught can use the cut as it is during the flush-water period of the river.

During the year careful surveys in detail have been made of all shoals and of localities of probable cut-offs on the river. The maps* of the shoals are numbered in regular order as they occur, the Oat Bed Shoal being number 1. The cut-offs are designated by letters of the alphabet, the first being Big Needle Eye A. Numbers 1, 2, 3, 4, A have been received by you, also Peach Tree Point. Numbers 5, 6, 7, 8, B, C, D, E, and another sketch of Peach Tree Point, are respectfully forwarded with this report. The soundings shown are reduced to dead low water, which is taken as the plane of reference, and is found in the dry season at the slack of the ebb tide when the water level is controlled by the action of the lunar tides. The fall of the river is very slight, the most careful leveling being necessary to find any at all. The average rise and fall of the tide at Georgetown is 3.5 feet daily. The average at Conway while the lunar tides last is 1.7 feet daily, and the greatest rise above dead low water observed in past season, when river was "flush" with rain water, was 6 feet. This was determined by recording accurate readings of a gauge kept at that place.

In the wet season, the action of the lunar tides is overcome by the rainfall, and then there is a constant fluvial current. The force brought about by the rainfall extends somewhere below the mouth of Bull Creek; but then even for a distance above the creek there may be a slight daily rise of the flood tide, but still no perceptible flood current. As the river wastes its supply of rainfall water, the lunar tide at once asserts itself, that portion of the river below Bucksville feeling its effect first, and then gradually the tide reaches to Conway, till at last a daily flood current is plainly observed.

A tabulated list of shoals and cut-offs is given below, showing such information as was collected by the recent surveys, and containing estimates of the probable cost of completing such improvements as are recommended for your consideration in connection therewith.

On all the shoals jetties or wing-dams have been partially constructed since the improvement first began.

At numbers 1, 2, 3, 4 they were considered completed, but having been hastily built of parallel rows of guide-piles, with space between packed with logs and brush (mostly brush), they have not stood well. In all of them are "break-throughs."

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* Omitted.

At numbers 5, 6, 7, 8 no filling-in was done for want of funds, but piles simply driven in rows. So they now stand. What beneficial effect has been accomplished by these finished it is impossible to say definitely. I am not aware of the existence of any record of soundings taken prior to their construction, reduced to a plane of reference upon a fixed system, with which comparative soundings could now be easily made. It is not doubtful, however, but that they have been the means of deepening the water on the shoals to a certain extent.

I am informed that boats of same draught have less trouble now on account of these sand-bars than they had before any work was done thereon. Undoubtedly sheet-pile jetties (see Sheet X*) would be preferable to use in continuing the improvement above all others, for the sake of their strength, durability, &c.

The fact though that they will be of necessity placed in deep water gives them a leverage above the bottom, which should have a corresponding depth below to secure their permanency. This largely increases the dimensions of the material used in their construction, and consequently adds much to their cost, besides the extra expense required of putting them down.

There is another and cheaper style of jetty (see Sheet Y* herewith sent) which is respectfully suggested for your consideration. It might be used satisfactorily. This is to drive strong guide-piles in rows about 1.5 feet apart, and then bolt timber hewn on two sides only 1 foot thick, solidly together forming a wall from bottom to a height of 3.5 feet above low water, with necessary braces at top of piles.

An objection to this is its liability to undermine and scour deep holes, but it might be prevented by first fastening to the bottom timbers, before sunk, a brush apron extending 8 or 10 feet above and below, which might be made to rest evenly on the bottom and hold thereby, an occasional rough pile being driven through it. The rough piles would also act as fenders to save the jetty from thrusts of rafts, &c., floating with the current. It is believed that there would be more or less settling, till limit to scour is reached, and sooner or later an extra piece of timber would have to be put in and bolted to the others, in order that the top might be made to again reach the braces. The material required for such structures would be only first class for so much of them as might be above the low-water level. Brush jetties are not thought favorably of for this stream. Their height above the bottom requiring large quantities of packing material would make them expensive. Aside from this the Waccamaw water depositing no clay to "chink up" the brush, it would never become tight, and much water would constantly be wasted through.

There is no reason known to the writer why, if jetties were properly constructed, contracting the width of the river, thus directing the current and accelerating its velocity upon certain fixed lines together with some dredging, the end desired might not be attained and remain so permanently. From all the information attainable on the subject, it would appear that to supply the present demands of commerce on this river a depth of 12.5 feet at the low-water stage of the lunar tides would be sufficient to Bucksville, and 12.5 feet at the average high-water stage of some tides from that point to Conway. Bucksville is a place of some importance, at which a large trade, especially in lumber, timber, and shingles, is carried on annually.

With the above in view, the following estimates are made of the probable cost of completing the improvement of the river between Conway and its mouth:

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* Omitted.

Tabulated statement containing estimates of probable cost of furnishing 9 feet at low water from Georgetown to Conway, channels 100 feet wide, and thence a cleared channel to Reeves Ferry.

SHOALS.

Number of shoals.	Name.	Distance from Georgetown.	Average length of shoal.	Present average depth on shoal at low water.	Desired depth on shoal at low water.	Approximate periods of lunar tides.	Rise and fall of same daily.	Velocity of current per hour.	Approximate period of constant fluvial currents.	Velocity of same per hour.	Jetties probably needed.	Probable cost, per foot, of solid-wall jetty.	Probable cost, per foot, of sheet-pile jetty.	Total cost of solid-wall jetties.	Total cost of sheet-pile jetties.	Dredging probably needed.	Probable cost, per cubic yard.	Amount for dredging.	Probably cost of improvement with sheet-pile jetties and dredging.	Probably cost of improvement with solid-wall jetties and dredging.	Difference between cost of improvement with solid-wall and sheet-pile jetties.
		Miles.	*Feet.*	*Ft.*	*Ft.*	*Mos.*	*Ft.*	*Miles.*	*Mos.*	*Miles.*	*Lin. ft.*					*Cu. yds.*					
1	Oat Bed Shoal	34	600	11.	9.	8	3.3	.58	4	1.09	.....	$2 41	$3 16	.....	.....	.....	15	.....	.....	.....	.....
2	Big Needle-Eye Shoal	35	800	11.	9.	8	3.2	.48	4	1.02	.....	2 41	3 16	.....	.....	.....	15	.....	.....	.....	.....
3	Mount Landing Shoal	45¼	3,400	8.7	9.	7	2.8	.60	5	1.20	1,800	2 41	3 16	$4,338	$5,688	1,500	15	$225 00	$5,913 00	$4,563 00	$1,350
4	Boat House Shoal	46	900	8.0	9.	7	2.7	.52	5	1.15	600	2 41	3 16	1,446	1,896	3,333	15	499 95	2,395 95	1,945 95	450
5	Green Landing Shoal	48½	700	8.5	9.	7	2.5	.53	5	1.12	500	2 41	3 16	1,205	1,580	1,296	15	194 40	1,774 40	1,399 40	375
6	Jackson Bluff Shoal	53	1,400	7.5	9.	6	2.0	.63	6	1.00	700	2 41	3 16	1,687	2,212	5,481	15	822 15	3,034 15	2,509 15	525
7	Indian Creek Shoal	56	800	8.0	9.	6	1.9	.53	6	1.00	700	2 41	3 16	1,687	2,212	2,962	15	444 30	2,656 30	2,131 30	525
8	Cox's Shoal	57	2,000	7.0	9.	6	1.8	.54	6	1.00	16,00	2 41	3 16	3,856	5,056	14,800	15	2,220 00	7,276 00	6,076 00	1,200
	Total	.....	.....	...	...	.....	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	...	.....	23,049 80	18,624 80	.....

Tabulated statement containing estimates of probable cost of furnishing 9 feet at low water from Georgetown to Conway, &c—Continued.

CUT-OFFS.

Number of cut-off.	Name.	Distance from Georgetown.	Average length of cut-off.	Top width.	Bottom width.	Average width.	Average total depth.	Probable clearing and grubbing.	Probable cost per square yard.	Amount for clearing and grubbing.	Dredging in cut.	Probable cost, per cubic yard.	Amount for dredging.	Total cost of cut complete.
		Miles.	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Square yards.*	*Cents.*		*Cubic yards.*	*Cents.*		
A.	Big Needle-Eye Cut-off	34.5	125	100	70	85	12.2	1,388	.50	$694 00	4,800	.33⅓	$1,600 00	$2,295 00
...	Peach Tree Point*	.37	.....	.....	.....	.....	12.2	1,004	.40	401 60	3,175	.30	952 50	1,354 10
B.	Through Creek Cut-off, Pot Bluff†	.49	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
C.	Indian Creek Cut-off†	.54	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
D.	Little Needles-Eye Cut-off‡	61.25	50	60	40	50	9.0	.....	.....	.....	834	.33⅓	278 00	278 00
E.	Burroughs Cut-off	61.50	200	60	40	50	12.	1,333	.50	666 50	4,444	.33⅓	1,481 33	2,147 83
	Total	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	6,074 93

* Three points cut off as shown on map.

† Cut-off not recommended at present.

‡ Clearing completed.

COST.

Nature of work, &c.	With sheet jetties.	With solid jetties.
Improvement of shoals, Georgetown to Conway, as above	$23,049 80	$18,624 80
Cut-offs	6,074 93	6,074 93
Diking off side creeks, 600 linear feet, at $2	1,200 00	1,200 00
Snagging between Georgetown and Conway	500 00	500 00
Snagging between Conway and Reeves Ferry	37,200 00	37,200 00
Totals	68,024 73	63,599 73
Superintendence, general and local, 10 per cent	6,802 47	6,359 97
Contingencies, 10 per cent	7,482 72	6,995 97
Grand totals	82,309 92	76,955 67

Tabulated statement containing estimates of probable cost of furnishing 12 feet at high water from Georgetown to Conway, channels 100 feet wide, and then to a cleared channel to Reeves Ferry.

SHOALS.

Number of shoal.	Names.	Distance from Georgetown.	Average length of shoal.	Present average depth on shoal at high water.	Desired depth at high water.	Approximate period of lunar tides.	Rise and fall of same daily.	Velocity of ebb current per hour.	Approximate period of constant fluvial current.	Velocity of same per hour.	Jetties probably needed.	Probable cost per foot of solid-wall jetty.	Probable cost per foot of sheet-pile jetty.	Total cost of solid-wall jetties.	Total cost of sheet-pile jetties.	Dredging probably needed.	Probable cost per cubic yard.	Amount for dredging.	Probable cost of improvement with sheet-pile jetties and dredging.	Probable cost of improvement with solid-wall jetties and dredging.	Difference between cost of improvement with solid-wall and sheet-pile jetties.
		Miles.	*Ft.*	*Ft.*	*Ft.*	*Mos.*	*Ft.*	*Miles.*	*Mos.*	*Miles.*	*Lin. ft.*	*Dls.*	*Dls.*	*Dols.*	*Dols.*	*Cu. yds.*	*Cts.*	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*
1	Oat Bed Shoal	34	600	14.3	12	8	3.3	.58	4	1.09	.....	.....	.....	.....	.....	.....	....	.....	.....	.....	.....
2	Big Needle Eye Shoal	35	800	14.2	12	8	3.2	.48	4	1.02	.....	.....	.....	.....	.....	.....	....	.....	.....	.....	.....
3	Mount Landing Shoal	45¼	3,400	11.5	12	7	2.8	.60	5	1.20	1,800	2 41	3 16	4,338	5,688	1,573	15	235 95	5,923 95	4,573 95	1,350
4	Boat House Shoal	46	900	10.7	12	7	2.7	.52	5	1.15	600	2 41	3 16	1,446	1,896	4,333	15	649 95	2,545 95	2,095 95	450
5	Green Landing Shoal	48½	700	11.0	12	7	2.5	.53	5	1.12	500	2 41	3 16	1,205	1,580	2,000	15	300 00	1,880 00	1,505 00	375
6	Jackson Bluff Shoal	53	1,400	9.5	12	6	2.0	.63	6	1.00	700	2 41	3 16	1,687	2,212	6,481	15	972 15	3,184 15	2,659 15	525
7	Indian Creek Shoal	56	800	9.9	12	6	1.9	.53	6	1.00	700	2 41	3 16	1,687	2,212	4,000	15	600 00	2,812 00	2,287 00	525
8	Cox's Shoal	57	2,000	8.8	12	6	1.8	.54	6	1.00	1,600	2 41	3 16	3,856	5,056	14,812	15	2,222 10	7,278 10	6,078 10	1,200
																			23,624 15	19,199 15	

Tabulated statement containing estimates of probable cost of furnishing 12 feet at high water from Georgetown to Conway, &c.—Continued.

CUT-OFFS.

Number of cut-off.	Names.	Distance from Georgetown.	Average length of cut-off.	Top width.	Bottom width.	Averaged width.	Averaged total depth.	Probable clearing and grubbing.	Probable cost per square yard.	Amount for clearing and grubbing.	Probable dredging in cut.	Probable cost per cubic yard.	Amount for dredging.	Total cost of cut complete.
		Miles.	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Sq. yds.*	*Cents.*	*Dollars.*	*Cu. yds.*	*Cents.*	*Dollars.*	*Dollars.*
A	Big Needle Eye Cut-off	34½	125	100	70	85	12	1,388	50	694 00	4,722	33⅓	1,574 00	2,268 00
....	Peach Tree Point	37*	.....	.....	.....	.....	.....	1,004	40	401 60	3,112	30	933 60	1,335 20
B	Through Creek Cut-off, Pot Bluff	49†	.....	.....	.....	.....	.....		.....	.....	.....	.....	.....	.....
C	Indian Creek Cut-off	54†	.....	.....	.....	.....	.....	(‡)	.....	.....	.....	.....	.....	.....
D	Little Needle's Eye Cut-off	61¼	50	60	40	50	12		.....	.....	1,111	33⅓	370 33	370 33
E	Burroughs Cut-off	61½	200	60	40	50	12	1,333	50	666 50	4,444	33⅓	1,481 33	2,147 83
														6,121 36

* Three points cut off as shown on map. † No work recommended at present. ‡ Clearing completed.

COST.

Location of work, &c.	With sheeted jetties.	With solid jetties.
Improvement of shoals, Georgetown to Conway, as above	$23,624 15	$19,199 15
Cut-offs	6,121 36	6,121 36
Diking off side creeks, 200 linear feet, at $2	1,200 00	1,200 00
Snagging between Georgetown and Conway	500 00	500 00
Snagging between Conway and Reeves Ferry	37,200 00	37,200 00
Total	68,645 51	64,220 51
Superintendence, general and local, 10 per cent	6,864 55	6,422 05
Contingencies, 10 per cent	7,551 00	7,064 25
Grand total	83,061 06	77,706 81

Statement showing portions of the Waccamaw River, South Carolina, worked over from beginning of improvement to time of suspension of operations in present year, June 2, 1885.

Number.	Name of places.	Distance from Georgetown	Pile driving and jettying.	Roughly cleared of obstructions.	Thoroughly cleared of obstructions.
		Miles.			
1	Georgetown		1881–'82. Completed pile driving on shoals. 1881–'82. Completed jetties on shoals.	1881–'82. Cleared obstructions from shoals only. 1883, trimmed banks.	1884–'85. Thoroughly cleared, so far as examination showed. Includes removing obstructions from bed of river and obstructions from banks.
2	Laurel Hill	21.00			
3	Mouth Bull Creek	26.00			
4	Oat Bed Shoal*	34.00			
5	Big Needle Eye Shoal	35.00			
6	Peach Tree Landing	37.00			
7	Bucksville	40.50			
8	Mount Landing Shoal	45.25			
9	Boat House Shoal	46.00			
10	Green Landing Shoal	48.50			
11	Pot Bluff Landing	49.00			
12	Jackson Bluff Shoal	53.00			
13	Indian Creek Shoal	56.00			
14	Cox's Shoal	57.00			
15	Pitch Landing	59.00			
16	Loggy Creek	59.50			
17	Conway	63.00			

* Drove twenty-eight piles at Oat Bed Shoal in 1885.

In continuing the improvement of the Waccamaw River, I would respectfully recommend that the work be extended at least as far up as Reeves Ferry, approximately 124 miles above Conway, with the view of obtaining 3 feet depth at low water. The principal obstructions to navigation are sunken logs, snags, and overhanging trees, which prevent much commerce from being carried on over this portion of the stream.

The work to be done first in preference is clearing the river of the above-mentioned obstructions to navigation for light-draught steamboats. For the removal of these obstructions, the following estimate is respectfully submitted:

One hundred and twenty-four miles from Conway to Reeves Ferry, at $300 per mile, 40 logs and stumps at $5 to be removed from channel, 60 large trees at $1, and 400 small trees at 10 cents	$37,200 00
For 11-foot navigation to Conway at high water	15,000 00
Total	52,200 00
General superintendence, per year Local superintendence, per year	5,220 00
Add 10 per cent. for contingencies	5,220 00
Total	62,640 00

The foregoing estimate for work below Conway is subject to modification, as information may be obtained relative to stretches of the river not included in recent surveys. The work recommended to be done next in preference, is securing the desired depths upon the shoals. The velocity of the fluvial current is supposed to be greater when the water is higher than it was when the foregoing observations were recorded. To arrive definitely at its exact speed would necessitate the making of daily trials during the flush-water season.

No estimate is submitted of probable cost of completing cut-offs at Through Creek and Indian Creek, sheets B and C,* because it is believed that this work is not of so vital importance at present as to deserve such an expenditure of money as would be needed for same.

The vessels, for want of sufficient water, only go as high up as Bucksville.

The steamers run to a point approximately 40 miles above Conway, which town has heretofore been considered the head of navigation, but since the commerce is growing to such an extent, brought about by the recent establishment of a regular line of steamers, it is thought for this reason that the limit to the navigation at present might be lengthened to the point reached by the boats. Large quantities of hewn timber, shingles, and, at least, 65,000 barrels of naval stores, and 500 bales of cotton are brought down by river from above Conway, and about 3,000 tons of general merchandise are yearly carried up. I learn the improvement most needed above is clearing the channel of logs and overhanging trees. The Waccamaw country is without the convenience of railroads, and the people look to the river entirely as an outlet for their products.

*Omitted.

COMMERCIAL STATISTICS.

The following statement of freights transported over the river is furnished for the fiscal year just ending, and the figures are collected from the most reliable sources:

EXPORTS.

Articles.	Quantity.	Value.
Naval stores.....barrels..	112, 428	$420, 605
Cotton.....bales..	1, 980	79, 200
Wool.....do....	25	1, 500
Hides.....do....	10	160
Wax.....barrels..	26	520
Ground-peas.....bushels..	2, 500	1, 875
Rice, rough.....do....	20, 000	20, 000
Rice, clean.....barrels..	12, 000	180, 000
Lumber.....feet..	10, 377, 000	103, 770
Shingles.....	2, 822, 000	14, 110
Total.....	.....	822, 740

In addition to the above there are shipped from the river in considerable quantities, but of which no reliable figures could be obtained as to value, &c., fruit, potatoes, wine, salt and fresh fish, wild game, poultry, eggs, &c.

IMPORTS.

General merchandise, hay, salt, lime, fertilizers, dry goods, groceries, &c., tons estimated, 10,400; value estimated, $728,000. Of the foregoing about 400 bales of cotton, 6 bales of hides, 6 bales of wool, 20,000 barrels of naval stores, 1,500,000 feet lumber, 6 barrels wax, and 5,200 tons general merchandise are shipped to and from Conway, besides all the fruit, one-half of the potatoes, three-quarters of the eggs, and all the wine. The commerce has been carried on by two steamers running regularly, about 70 sail of vessels—the average carrying-tonnage of each, approximately, is 500—and numerous pole-flats. Up to the year 1875 all the exports, except lumber, shingles, and some of the products of the lower river, were carried from above to Pot Bluff Landing, 49 miles from Georgetown, in pole-flats, and shipped thence, by about 14 sail of light-draught vessels, yearly to its destination. About 40 sail of larger vessels were required then, besides the above, to transport lumber, &c., from points below.

During the year 1875 the total probable value of the exports for the river amounted to $432,274. No approximate value can be arrived at for the imports for the same time. Towards the close of that year a small steamer was put on the river from Conway down. Comparisons made between the present year and that of 1875 indicate a steady increase of the business on this stream.

It is believed that if deeper water could be furnished over the shoals new industries would spring up, which would no doubt increase the commerce much more rapidly, and, consequently, the prosperity of the adjacent country.

The distances given are necessarily very uncertain, being arrived at from the speed of boats running on the river. These distances are subject to change, as the stream may be measured in continuing the improvement.

Machinery was hired and material and supplies purchased in open market.

In connection with the work I wish to add that Mr. Thomas O. Stuart, time-keeper of this work, has been prompt and efficient in the performance of his duties.

Very respectfully, your obedient servant,

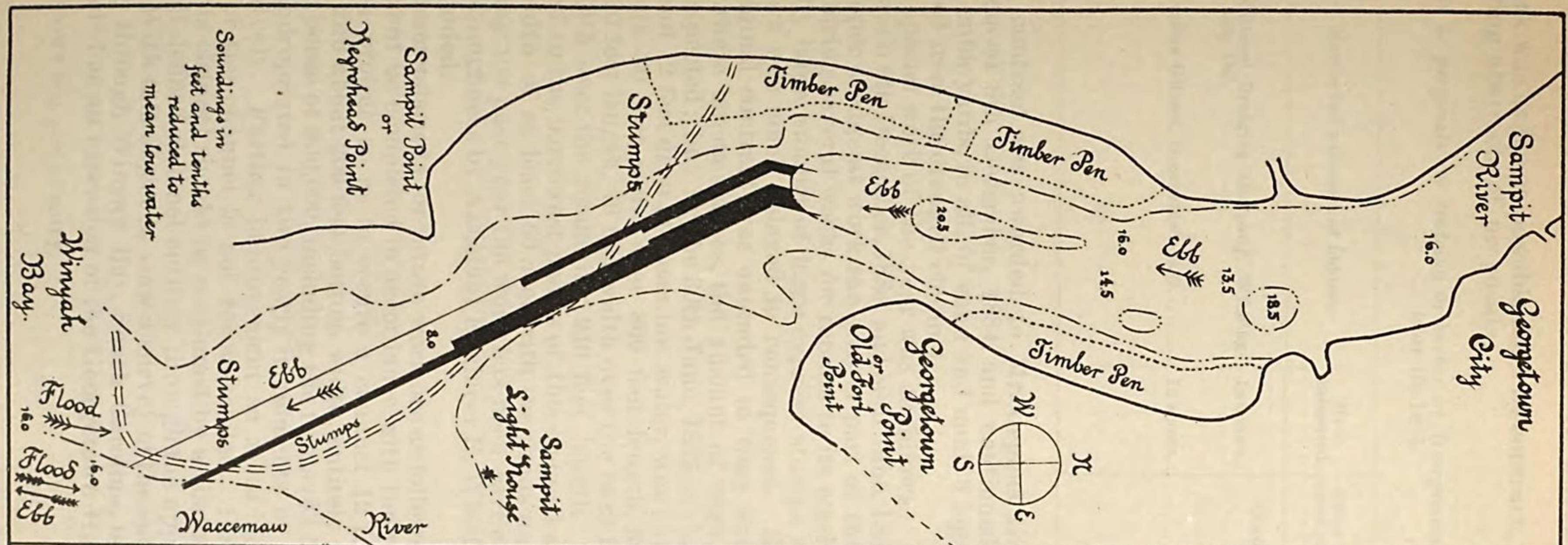
REID WHITFORD,
Assistant Engineer.

Capt. W. H. BIXBY,
Corps of Engineers.

M 11.

IMPROVEMENT OF GEORGETOWN HARBOR, SOUTH CAROLINA.

The amount appropriated by act 5th July, 1884, together with the funds available, was too small for economical work, but improvement was so much needed that small immediate actual results were regarded as more valuable than larger but delayed possible ones.



Georgetown Harbor

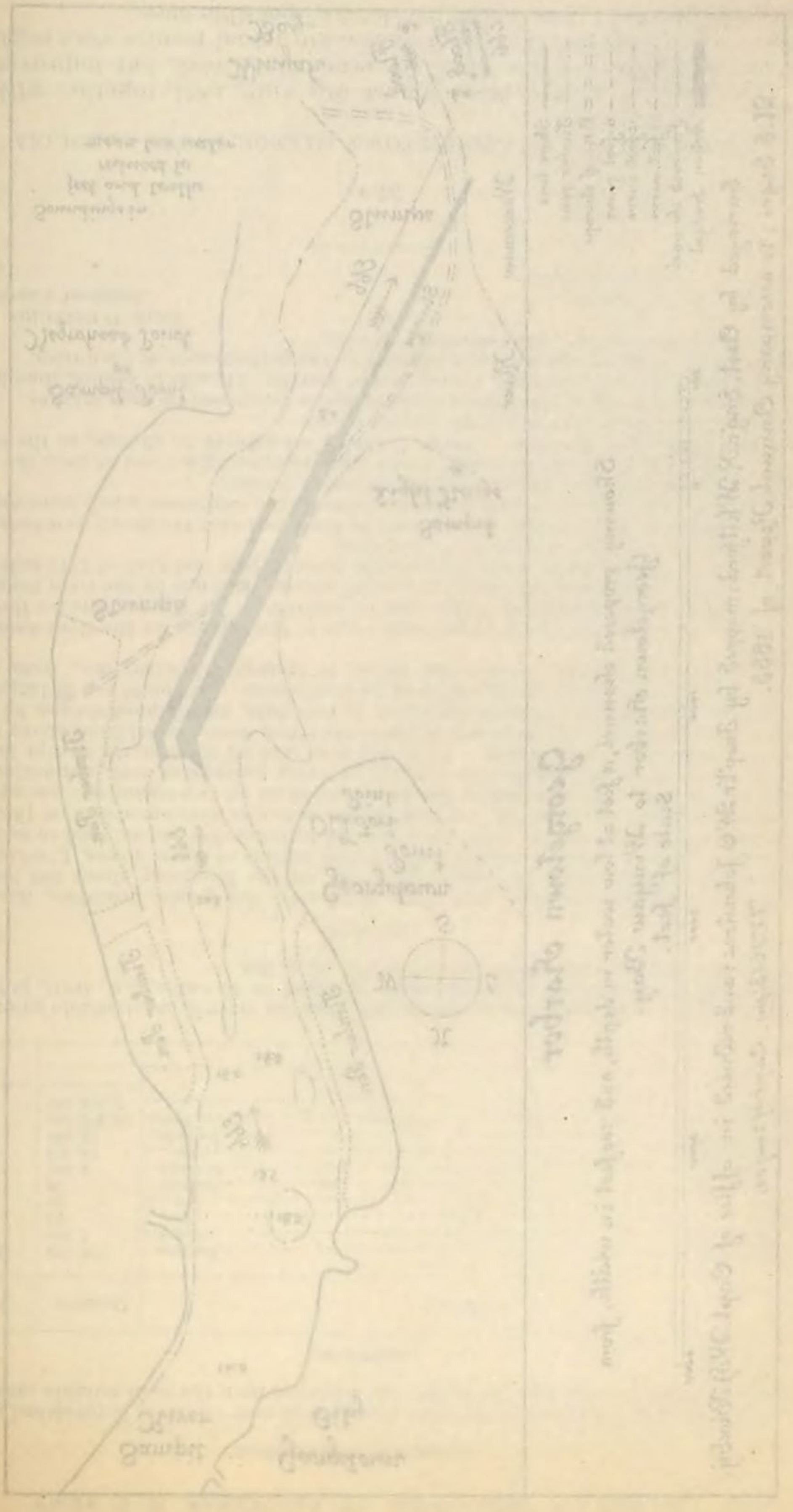
Showing proposed channel, 12 feet at low water in depth, and 200 feet in width, from Georgetown Harbor to Winyaw Bay.

Scale of feet.

Surveyed by Asst. Eng'r. R. Whitford; mapped by Insp't'r. W.C. Johnstone; and reduced in office of Capt. W.H. Bixby, U.S. Engrs; to accompany Annual Report of 1885.

W.H. Bixby Capt of Engrs.

H Ex1 pt2 v2 491



Work was as far as possible done by contract, in accordance with the following abstracts of proposals:

Abstract of proposals for dredging in harbor at Georgetown, S. C., opened at 12 m. October 15, 1884.

No.	Names and addresses of bidders.	How measured.	Price per cubic yard.	Remarks.
			Cents.	
1	National Dredging Company, Wilmington, Del.	In scows..	18	Commence on or before November 15, 1884, and complete by February 15, 1885.
2	Cephas Gilbert, Georgetown, S. C.....	In scows..	12½	Commence November 29, 1884, and move not less than 10,400 cubic yards per month. (Will complete at this rate in about six months.)

The contract was awarded to Mr. Cephas Gilbert. His work was commenced 8th December, 1884, and continued to 30th June, 1885; 20,924 cubic yards, in all, of sand and mud, 3 logs, and 75 stumps were removed from the dredged channel.

The special work of the year was as follows:

Between 8th December, 1884, and 30th June, 1885, the contractor kept one dipper dredge at work the greater part of the time, stopping, however, during several weeks for repairs to its machinery. A very unexpectedly large number of large cypress stumps were encountered, and the work was much delayed in consequence. Mainly for this reason the original contract was extended in time until 22d January, 1886. Under these circumstances, the amount of work done was much less than expected; but by the 30th June, 1885, a channel about 2,640 feet long, and 12 feet deep at mean low water, was cut entirely through the bar, with 80 feet width over 860 feet length, 60 feet width over the next 720 feet length, 40 feet width over the next 120 feet length, and 20 feet width over the remaining 940 feet length. Further work will be confined to the narrowest points of this channel so as to secure a uniform width of at least 60 feet with the funds now available.

During the past year the work has been carried on with great vigor and thoroughness by Assistant Engineer R. Whitford, whose full report is appended.

Recommendations for future work are as follows: That the above improvement be completed in accordance with the present approved and adopted project, so as to secure a channel 12 feet deep, at mean low water, and about 200 feet bottom width, entirely through the bar, at a total expense of $30,000, including the funds ($3,566.15) now available, to be appropriated in two yearly instalments of $20,000 and $10,000, respectively. Further improvement so as to increase the depth and width of this channel is not recommended. However, it is desirable that this channel should be continued by a similar, easy, well-marked, and well defined channel entirely through the upper portion of Winyaw Bay. With this object in view a survey of the entrance to Georgetown Harbor through Winyaw Bay, South Carolina, is desirable and is recommended as an extension of the Georgetown Harbor improvement.

Georgetown is a port of entry.

Money statement.

July 1, 1884, amount available		$7,000 00
Amount appropriated by act approved July 5, 1884		5,000 00
		12,000 00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$5,750 80	
July 1, 1885, outstanding liabilities	2,683 05	
		8,433 85
July 1, 1885, amount available		3,566 15
Amount (estimated) required for completion of existing project		30,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		20,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

REPORT OF MR. REID WHITFORD, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Georgetown, S. C., June 30, 1885.

CAPTAIN: I have the honor to make the following report of work improving Georgetown Harbor, South Carolina, for fiscal year just ending.

A contract for dredging was entered into with Mr. Cephas Gilbert, and operations commenced at the lower end of the channel proposed to be made through the shoal at the mouth of Sampit River, on 8th December, 1884. At this point large-sized cypress stumps were found deeply rooted in the bottom. To avoid them till preparations might be made regularly for their removal, and thinking a cut might be finished through to Winyaw Bay, so as to escape them, the dredge was allowed to begin at the upper end of the channel. When a cut had been completed down for about 1,200 feet stumps were again encountered and a second time the dredge hauled back to another, and after proceeding for about 600 feet the result proved to be the same.

It was now determined to try a cut on the extreme eastern side. As the stumps projected from Sampit Point, it was thought likely that they did not extend so far as to reach the cut now undertaken, and that it would be put through with dispatch; but after going down about the same distance stumps once more appeared, which was convincing that the "stumpy area" stretched entirely across the channel proposed to be dredged. To arrive approximately at the extreme eastern boundary line of this area, a hoisting machine (having a steam force-pump of considerable power, with iron piping through which jets of water were discharged) was employed to probe thoroughly the bottom. This having been done, a map showing the boundary lines of the stumpy area as fixed by the probing pipes was sent you some time since. It was decided that no change could be made in the direction of the original lines laid out for the channel without bringing about very marked cross-currents of both ebb and flood tides, which in all probability would fill up the cut about as soon as excavated unless expensive diking was resorted to; and for these reasons there would be no deviation from the first lines fixed, which lie generally in the thread of the ebb current. This will likely prevent any filling in. Pending the decision as to a change the dredge was kept at work above the "stumpy area"

At present the work has been finished on cut number 8, 12 feet deep at mean low water, and 20 feet wide, to the 12-foot depth in Winyaw Bay. There have been a total of 20,924 cubic yards of materiai removed, 3 logs, and 75 stumps of trees of 1 foot and over in diameter. Sheet G,* herewith sent, shows work completed and to be done; also the approximate boundary line of the stumpy area. The completion of this work will be of very great benefit to the commerce of Georgetown, and among many of the advantages to be derived from it is that the shoal obstructing the entrance to the harbor, once removed, will permit vessels to leave Georgetown and cross the bar at the entrance to Winyaw Bay, 16 miles off, on the same tide. At present much time is taken and expense caused by having to carry the sea-going vessels over this shoal at one high water, and then the next one must be awaited to carry them over the outer bar, which may consume twenty-four hours' time from first to last.

The existence of the stumps has greatly retarded the progress of the work and very materially increased its cost over the first estimate. There was no provision made for them in that estimate. Common excavation of mud and sand was only expected. It is now found to be a fact that a large proportion of the bottom of the entire lower

---

* Omitted.

half of the proposed channel is thickly covered with formidable stumps, which wil be expensive to remove.

I would respectfully recommend a continuation of the work under the existing project, which contemplates furnishing a channel 200 feet wide, with a depth of 12 feet at mean low water. It is hardly possible to even approximate the number of stumps left to be removed, but, taking all things into consideration, together with the examinations made, their number is taken as given in the estimate of the probable cost of completing the existing project, which I respectfully submit for your consideration, as follows:

500 stumps, at $40 each	$20,000 00
4,500 cubic yards excavation, at 12.5 cents per yard	5,625 00
General superintendence, per year	1,000 00
Local superintendence, per year	1,500 00
Total	28,125 00
Add 10 per cent. for contingencies	2,812 50
Total	30,937 50

The cost of doing the work is based on the present prices received by the contractor. The importance of Georgetown as a commercial center, it is thought, entitles it to the completion of this work for the commerce and benefit of navigation of its harbor. The late Capt. Charles B. Phillips, Corps of Engineers, United States Army, fully set forth in his report at the time of the survey made, in connection with the above work, the prominence of Georgetown in a commercial sense. I take the liberty of copying an extract from Captain Phillips's report, as follows: "Georgetown is situated on the head of Winyaw Bay, South Carolina, at the confluence of the Pee Dee, Waccamaw, Black, and Sampit rivers. It is a port of considerable and growing importance, and will become a large city when its natural advantages are made use of. It is the natural outlet of a vast section of fertile country, the principal products of which are cotton and rice. Almost inexhaustible quantities of timber and naval stores are also to be found on the streams tributary to Winyaw Bay."

I am indebted to Mr. John I. Hazard, a prominent business man of this place, who is largely interested in shipping, for the inclosed communication concerning the commerce of the harbor.

My thanks are due to Mr. W. C. Johnstone, inspector of this work, for the thorough, efficient, and prompt performance of his duties. There is no better place to express my thanks, also, to Mr. William Alden James, rodman, for the faithful and intelligent manner of his assistance to me in his duties connected with the various works under this office. He is recommended as a faithful and hard worker wherever his services may be needed.

Very respectfully, your obedient servant,

REID WHITFORD,
Assistant Engineer.

Capt. W. H. BIXBY,
Corps of Engineers.

COMMERCIAL STATISTICS.

GEORGETOWN, S. C., *June* 18, 1885.

DEAR SIR: In compliance with your request I take pleasure in furnishing the following commercial statistics for Georgetown Harbor, South Carolina, for the year just passed:

Articles.	Quantity.	Value.	Articles.	Quantity.	Value.
Lumber ..... feet	11,125,625	$139,070 31	Balusters	1,400	$28 00
Shingles	6,154,875	76,935 93	Peas ..... sacks	221	254 15
Timber ..... feet	75,500	948 75	Rough rice ..... do	200	600 00
Resin ..... barrels	136,529	204,888 00	Black walnut ..... feet	1,200	60 00
Spirits turpentine ... do	26,835	362,525 00	Furs ..... cases	12	1,200 00
Cotton ..... bales	8,148	407,400 00	Wine ..... barrels	68	3,500 00
Rice ..... barrels	13,349	240,282 00	Crude turpentine .. do	35	87 50
Tar ..... do	1,940	2,425 00	Cotton-seed ..... sacks	2,435	1,218 00
Wool ..... bales	48	4,800 00	Tallow ..... barrels	4	50 00
Hides ..... do	85	4,250 00	Peanuts ..... sacks	50	200 00
Wax ..... barrels	12	480 00			
Cross-ties	6,010	2,103 50	Total	.....	1,453,438 14
Cypress staves	11,000	132 00			

The approximate value of imports, consisting of general merchandise, hay, salt, lime, fertilizers, &c., is $954,000 to Georgetown proper, and $765,000 to up-river landings.

The commerce is carried on by about 30 sail of sea-going vessels of about 300 tons (average) capacity each. There are also 7 steamers employed on the rivers and plying between this port and Charleston, S. C.

Two first-class tug-boats do the towing and are kept quite busy during the entire year. In addition to the above there are numerous small sailing craft, pole-flats, and other boats, bringing and taking freight, but of which no account can be gotten.

The importance of Georgetown as a commercial sea-port can hardly be exaggerated. This statement would perhaps not be sustained by the present actual volume of trade, which centers here, but viewed in the light of possibilities it is more than justifiable. Set like a jewel at the mouths of four great rivers, which, with their tributaries, water one-half of the State, the town is potentially the equal of the most thriving and prosperous sea-port on the South Atlantic coast.

The rivers which empty into the Winyaw Bay at Georgetown penetrate the most fertile regions of the State. There are no more productive lands in the South than those watered by the Great Pee Dee and Wateree rivers. Along the Santee are found immense quantities of timber of the finest quality for building and shipping purposes. It may safely be asserted that the only obstacle to the development of this territory and the establishment of a large trade between it and Georgetown is the lack of a sufficient depth of water on the bar to accommodate ocean-going vessels. As long as the greatest attainable depth does not exceed the present maximum, there will be little or no chance of establishing a direct European trade. But, with an increase of 6 or 8 feet, there can be no doubt that a flourishing export trade in lumber, naval stores, cotton, and rice would at once spring into existence. These possibilities are enhanced by the fact that a trunk-line connecting Georgetown with the West is now in contemplation and work on a portion of it actually begun. Such a railroad, in connection with a deepened bar, would give an astonishing impetus to the business of Georgetown and elevate her to the rank of a first-class seaport with a rapidity that would be phenomenal. It would make Georgetown, in fact, what she is already by nature, the outlet and distributing point for nine-tenths of the produce of the whole of that portion of the State lying north and east of the Santee River, as well as of a considerable belt of territory skirting that river on the south. This statement does not include the enormous quantity of produce that would probably seek this port from North Carolina, Tennessee, and neighboring States.

Owing to the inability of Georgetown to improve her natural advantages and develop her natural resources, a forced and unnatural condition of things has arisen, by means of which the bulk of the produce from this section of the country has been diverted from its proper channel and compelled to seek an outlet elsewhere. Other seaports, both to the north and to the south, have thus prospered at the expense of Georgetown.

It is my sincere conviction, arrived at after considerable thought and reflection on this subject, that this abnormal state of things could be removed and the natural equilibrium restored by increasing the depth of water on the bar at Georgetown, and thus enabling her to furnish the shipping facilities necessary to accommodate the business that would flow down to her wharves. As was said by Capt. C. B. Phillips, of the Corps of Engineers, in a former report upon a survey of Georgetown Harbor, "It is a port of considerable and growing importance, and will become a large city when its natural advantages are made use of." A review of the trade of Georgetown during the past year exhibits a slight falling off, which, however, is properly attributable to the general depression that has affected every branch of industry during that period. The only wonder is, that the universal stagnation has not produced a more marked effect upon the volume of business done at this port. Considering the widespread decline of values and contraction of commerce, the decrease in the amount of trade done by Georgetown is surprisingly small.

One feature of our commerce deserves special notice, and that is the increase in the number of large three-masted vessels engaged in the carrying trade. The tonnage of these vessels ranges from 400 to 500 tons each, and they are fast superseding the smaller craft which once proved equal to the demand of the trade. This change in the character of our vessels, their greater draught of water, their superiority of construction, and the greater amount of capital invested in them constitute a strong argument for the increase of water on the bar, not only in order to facilitate commerce, but also to protect as much as possible from loss by unsafe navigation the large amount of capital invested in these vessels.

I append the following slip, taken from the Trade Review for the year 1883:

"Georgetown's unrivaled natural advantages, great as they are, lack one important feature—a sufficient depth of water on her sea-bar. The highest attainable depth is now 14 to 14.5 feet, which can only be had on spring tides or during the prevalence of easterly winds. The average depth is 12.5 to 13 feet. Unless improvements can be had

in this direction it is evident that Georgetown cannot become to any considerable extent a distributing point for foreign exports. But as, without this, she cannot hope to rival or even emulate the other Atlantic seaports, the deepening of her bar, by any system which may be found practicable, becomes a matter of the highest importance. With the possibility of railroad connection with the West, and her present geographical position at the confluence of streams which drain more than one-half of the counties of the State, embracing in their area vast tracts of enormous fertility, it may not unreasonably be affirmed that Georgetown has strong claims upon the General Government for appropriations to be applied to this great work."

I am, very respectfully, your obedient servant,

JOHN I. HAZARD.

MR. REID WHITFORD,
Assistant Engineer.

M 12.

IMPROVEMENT OF SANTEE RIVER, SOUTH CAROLINA.

The amount appropriated by the act of 5th July, 1884, together with the funds then available, was too small for economical work, but improvement was so much needed that small immediate actual results were regarded as more valuable than larger but delayed possible ones.

Owing to the experimental nature, its variable features, and the difficulty of properly specifying it beforehand and inspecting it afterwards, the work was allowably done by hired labor and the purchase of materials in open market.

The special work of the year was as follows:

Work was continued during the whole year, and was confined entirely to dredging along the proposed line of canal. Buried cypress logs and veins of hard sand were encountered in unexpected amounts, much delaying the progress of the work. During several weeks, but at the expense of the dredge owner, the dredging was stopped entirely for necessary repairs to the machinery. In this way 5,915 linear feet of canal were dredged to 30 feet width and 5 feet depth at low water, and 47,625 cubic yards of material removed therefrom.

A careful but inexpensive stadia survey was made of the whole of Mosquito Creek, and also of the finished and proposed cuttings, so as to serve as a sure basis for future work.

The location and surroundings of the projected draw-bridge were examined, and plans for its construction were drawn up ready for future use.

The canal, as far as finished, should have its caves redredged and should then be revetted, but the available funds are not sufficient to justify the present commencement of this work.

During ths past year this work has been carried on with great vigor and thoroughness under the immediate supervision of Assistant Engineer R. Whitford, whose report is appended.

Recommendations for future work are as follows: That this improvement be completed in accordance with the present approved and adopted project of 1881, so as to secure to the Santee River a straightened canalized outlet through Mosquito Creek, 7 miles long, 30 feet wide, and 6 feet deep at mean low water, including the construction of one small draw-bridge over this creek, at a total expense of $80,000, including the funds ($16,647.05) now on hand, to be appropriated in two yearly installments of $40,000 each.

It is also recommended that this improvement be extended in accordance with the proposed original project of 1880, so as to secure a safe

and unobstructed 7-foot navigation from the mouth of the Santee River 154 miles upward to Wright's Bluff, and thence a similar 5-foot navigation 30 miles further to its head in the Congaree and Wateree rivers, at a total expense of $65,000, to be appropriated at once in a single sum for expenditure during the next year. It is now estimated that this last-recommended improvement would at once, as already shown by past experience on the neighboring Pee Dee River, increase the Santee River commerce from $1,000,000 to $2,000,000 per year. Further improvement, so as to increase the above widths and depths of either canal or river, is not recommended until commerce shall have shown a further immediate necessity therefor.

I have further to recommend that such portion of the amount appropriated for the improvement of the Santee River, South Carolina, as is deemed advisable by the Secretary of War, may be used for acquiring the right of way for the proposed project, the said right of way to be obtained by agreement with parties interested, or, in the event of failure to make a reasonable agreement, by condemnation, as provided for by the laws of the State of South Carolina.

This river is in the collection district of Georgetown, S. C.

Money statement.

July 1, 1884, amount available		$17,049 58
Amount appropriated by act approved July 5, 1884		15,000 00
		32,049 58
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$14,592 96	
July 1, 1885, outstanding liabilities	809 57	
		15,402 53
July 1, 1885, amount available		16,647 05
Amount (estimated) required for completion of existing project		145,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887. Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		80,000 00

REPORT OF MR. REID WHITFORD, ASSISTANT ENGINEER.

GEORGETOWN, S. C., *June* 30, 1885.

CAPTAIN: I have the honor to report as follows upon the improvement of Santee River for fiscal year ending this day.

Operations have been carried on under the existing project.

The progress of the work was retarded by encountering large cypress logs deeply embedded in the soil across the line of the cut, which were disposed of by blasting with dynamite, and by unexpectedly by coming in contact with veins of densely packed hard sand underlying the surface of the ground. The sand was first found at station 100 plus 50 (stations 100 feet apart) on October 13, 1884, and, after laboriously and slowly cutting through it, was passed at station 105, when the dredge resumed excavating ordinary material, mud and black or bluish clay. This continued till April 16, 1885, at station 128 plus 44. Here another vein of sand made its appearance, and since that time the machine has been worked with considerable difficulty and much delay, caused by the unusual wear to machinery, rendering necessary many stoppages for repairs and removing it from the cut. This sand extends downward from 3.5 to 5 feet below top of cut—the face of the cut is 8 feet from top to bottom—and from examinations made with a probing bar of iron, it reaches from present position of dredge to within 86 feet of Lagoon Creek, distance 1,644 feet. At this point the sand dips below the bottom of the cut, or else ceases to exist, and ordinary material appears for a distance of 1,726 feet, when the sand is again found, and continues for a distance of 2,200 feet; thence ordinary material for a distance of 1,360 feet to U, the junction of the cut with Mos-

Map of Santee River S. C.

Showing the part via Mosquito Creek improved and in process of improvement under the direction of

Capt Wm H. Bixby Corps of Engrs U.S.A.

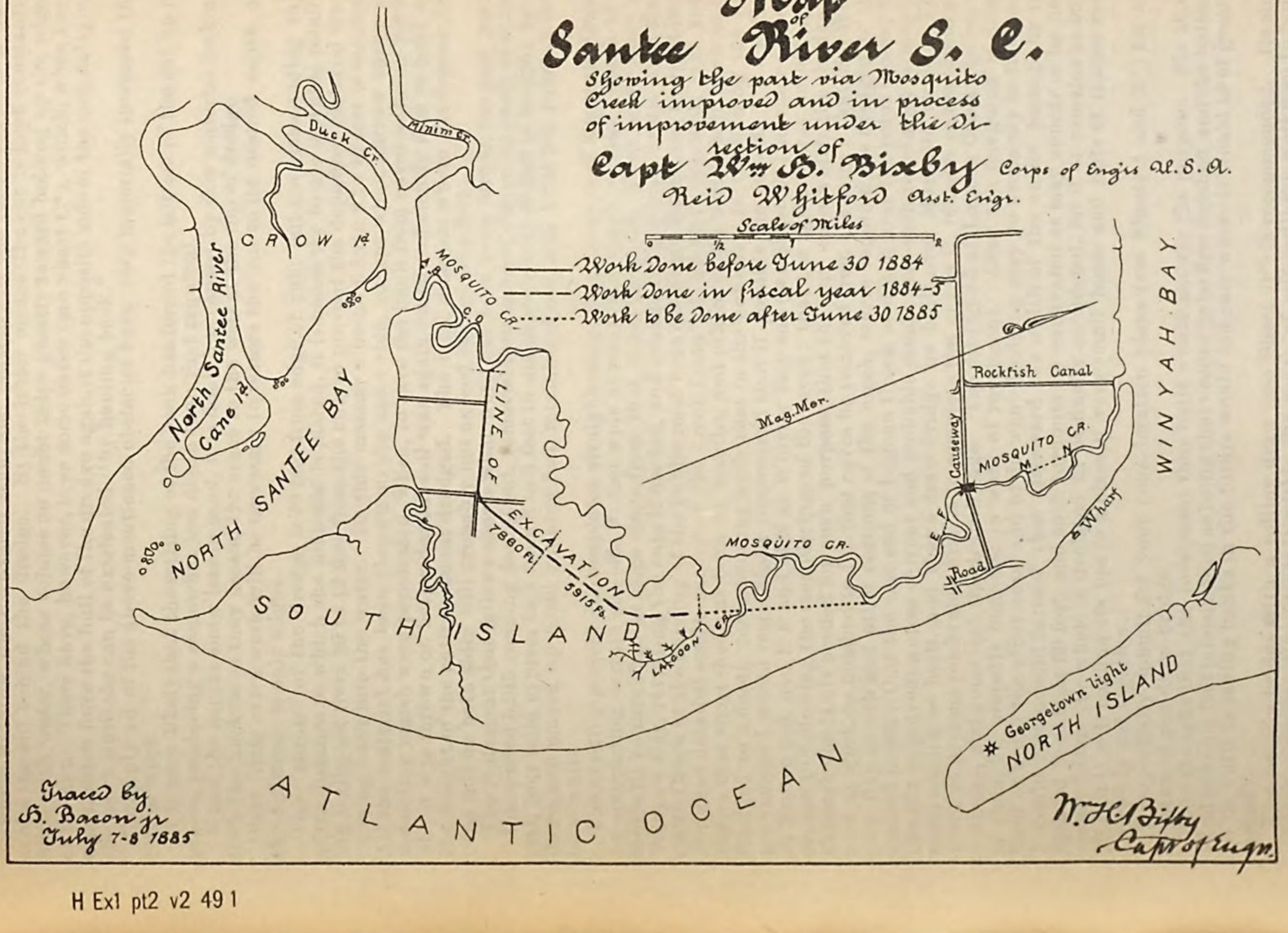
Reid Whitford Asst. Engr.

Scale of Miles 0 ½ 1 2

——— Work Done before June 30 1884

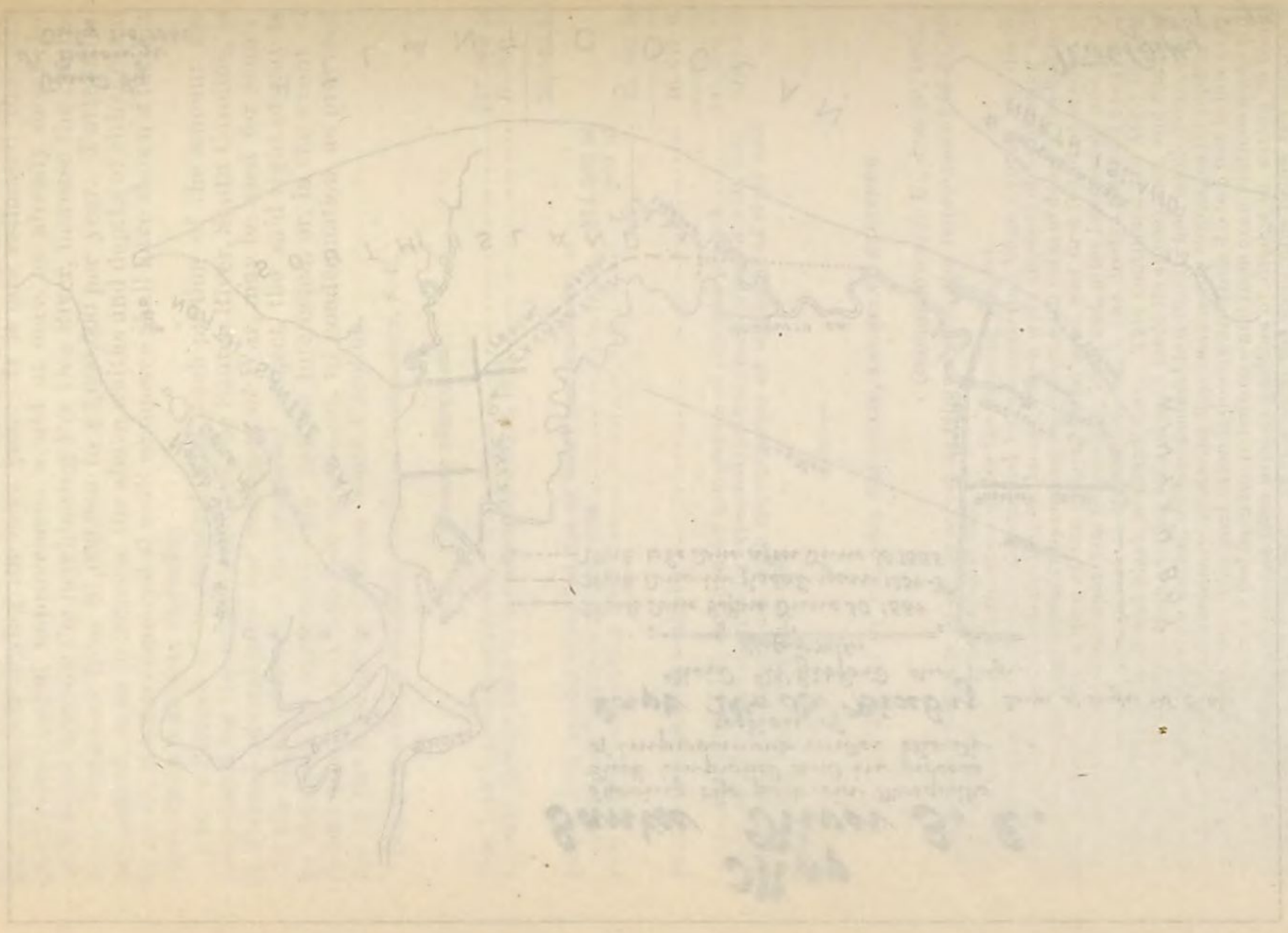
– – – Work Done in fiscal year 1884-5

·····Work to be Done after June 30 1885



Traced by
H. Bacon jr
July 7-8 1885

W. H. C. Bixby
Capt Corps of Engrs



quito Creek. (See Sheet C*, profile of the entire length of cut from initial point to cut to U). The side of the cut has caved less under the weight of the deposited material for the last completed 9,700 feet than it did for the first 4,200 feet. This has probably been due partially to the existence in the last portion of the cut of more compact soil on which to throw the excavated stuff, and partially to the construction of a dam across the cut behind the dredge. By the latter means the cut is kept constantly filled with water, whose volume no doubt helps greatly toward holding up the edges of the cut. There have, however, been some caves (see Sheet C*), which, when they occur, often force the hull of the dredge against the opposite side of the cut, delaying the work until she can be extricated "by hauling back."

Certainly all of the above-mentioned obstacles have very materially increased the cost of work.

It is very likely that the settling of the bank has forced the bottom of the cut up in places, producing a somewhat less depth than that required.

When the depths show less in sand, it is doubtless caused by this material leaking from the buckets as they ascend the crane to the well at the top of dredge.

Very little extra work will be necessary to restore the cut to its desired depth, as the difference is only slight.

The "throw" of the dredge is 40 feet from edge of cut; but notwithstanding this extra distance to which the material is placed, it is necessary to use movable retaining-walls, set from 10 to 12 feet from the cut, to prevent the deposited material from running back into the water. In this manner a bern of from 8 to 10 feet is secured. All the material has been thrown on the same side, except when narrow spaces of trembling marsh were penetrated, when, to save the bank from caves as far as possible, it was thrown on both sides till soil was again found sufficiently firm to hold up the weight of the entire amount dredged. The total distance where the deposit has been put on both sides will probably not exceed 500 running feet.

The statement that follows shows what work has been done during the past year.

Completed 5,915 running feet of cut, removed from same 47,625 cubic yards of material, four solid cypress logs from 3 to 5 feet in diameter, about 40 feet in length; took down and moved up 6,040 running feet retaining-walls, and built 500 running feet new walls.

The existing project contemplates straightening the sinuosities of Mosquito Creek by completing certain cut-offs 30 feet wide at mean low water, so that a depth of 6 feet will be furnished at same stage from that depth in Santee River to the same in Winyaw Bay, revetting the cuts if needed, and constructing a draw-bridge over Mosquito Creek at the crossing of the public road between South Island and Georgetown. A recent detailed stadia survey of the creek (map* of which is herewith sent you) shows that short shoals at both its mouths, and others in the creek, will have to be dredged to a depth corresponding with that in the cut-offs. In continuing the improvement I would respectfully recommend that if possible the cut-offs A B and C D at Santee end, and E F and M N at Winyaw Bay end (see Sheet D*) be made in preference to following the meanderings of the creek; that the right of way be obtained through the lands needed for such purpose, that the cut upon which the dredge is now at work be finished to U; that caves be removed from the same; that the Winyaw Bay mouth and other portions of the creek, where required, be dredged to the desired depth; that the east end of Lagoon Creek be diked near the point crossed by the cut to prevent a cross current and probable shoal; that such revetment as may be most needed be built, and that a draw-bridge be built over Mosquito Creek. The work to be done preferably first is to complete the cut to U, remove caves, build revetment, and construct the draw-bridge. The diking off of Lagoon Creek can be, it is thought, properly included in work of revetment. After the foregoing is done, then to finish the other cuts, and to do what dredging may be necessary in the creek I would recommend further that afterward the width of the entire passage be increased to at least 60 feet, and such turnouts be excavated as may appear to be necessary before the whole is declared to be finally completed, for if it remains at only 20 feet it will confine its use to a class of very small boats and rafts of timber very narrowly put together.

I respectfully submit for your consideration plans (see Sheets A and B*) for the revetment and draw-bridge.

It is thought that the revetment thus built would answer the purpose. Six thousand running feet is mentioned as being that needed to be first finished, and the balance to be built as caving banks in the future would indicate where it would be of greater benefit.

The use of a bridge with a rolling draw (see Sheet B*) is recommended. Its simplicity of construction places it within the reach of any ordinary workman to build and repair. It is easily operated by one man. It is light and at the same time strong. Its iron cylinder piers makes it permanent. The teredo would destroy wooden foun-

*Omitted.

dations unless protected. The water at the bridge is often salt for a whole season. When rolled back to allow passage of boats a clear opening of 40 feet is left with no overhanging obstructions, as is the case with a revolving draw. In a stream so narrow it is claimed that this is no little advantage. Aside from this, the cost of this bridge is thought to be reasonable when compared with other structures of like character with permanent foundations.

With the above in view, the following estimate is made of the probable cost of completing the work to cuts 30 feet wide and 6 feet deep at mean low water:

6,400 cubic yards excavation in Cut A B, at 25 cents per yard	$1,600 00
5,500 cubic yards excavation in Cut C D, at 25 cents	1,375 00
63,130 cubic yards sand and mud to U, at 37½ cents	23,673 75
10,940 cubic yards mud in Cut E F, at 25 cents	2,735 00
23,688 cubic yards mud in Cut M N, at 25 cents	5,922 00
9,000 cubic yards mud in Mosquito Creek, at 25 cents	2,250 00
13,500 cubic yards caves, at 25 cents	3,375 00
10,000 running feet retaining-walls, at 14 cents	1,400 00
6,000 running feet revetment, at $2.59 per foot	15,540 00
(See Sheet A for estimate in detail.)	
100 running feet diking off Lagoon Creek, at $5	500 00
1 rolling draw-bridge, complete	2,560 00
(See Sheet B for estimate in detail.)	
Total	60,930 00
General and local superintendence, 10 per cent. per year	6,093 00
Contingencies, 10 per cent	6,093 00
Total	73,116 00

The importance of this work is unquestionable, since it gives the Santee River and its tributaries an outlet into Winyaw Bay; thence a connection by sea.

It is believed that this work will soon grow into one of great commercial importance. Its completion is anxiously looked forward to by the people on the Congaree and Wateree rivers, and by others, who will at once establish lines of steamers between Winyaw Bay and points on the upper rivers.

As soon as the cut is completed on which the dredge is now at work, caves removed, and draw-bridge constructed, the passage through can be said to be open and ready to be used by a class of small boats.

Mr. L. S. Ehrich, a prominent and public-spirited citizen of Georgetown, has kindly prepared and furnished the following relating to the commerce on the Santee, present and prospective, which I bodily copy in this report:

"OFFICE OF LOUIS S. EHRICH,
"*Georgetown, S. C., June* 15, 1885.

"SIR: In compliance with your request, I have the pleasure to submit to you the following commercial statistics as to Santee River:

"The commerce of this river has undergone very little change, a slight decrease in shipments of cotton being caused by general short crops in this section of the State. The decrease in the amount of lumber and shingles is owing to the fact that it has proved to be entirely impracticable to risk getting vessels of even very light draught over Santee Bar; and as shipping by steamers that now trade on river to Charleston and thence to New York or Philadelphia, which are the markets for this product, is too expensive, this branch of trade must be abandoned unless they can get an outlet through Mosquito Creek into Winyaw Bay. In the single item of shingles, with outlet above referred to, an enormous business would be done, and I do not hesitate in asserting that one year after completion of Mosquito Creek Canal the shipment of shingles from this river will be fully 15,000,000. A supply of cypress timber along said river is almost inexhaustible. The Palmetto Mills of Georgetown, which require 8,000 sticks per year, worth $50,000, look to this section for their supply in future. In fact no portion of South Carolina offers the inducement to lumber and shingle manufacturers as does the Santee River with its multitude of virgin forests. All that is necessary to fully develop same is the outlet proposed via Mosquito Creek into Winyaw Bay. The following amounts of freight have been transported over this river during past year, the commerce being carried on by four steamers and numbers of small vessels of about 50-ton capacity:

OUTWARD.

Articles.	Quantity.	Value.
Cotton ..... bales..	9,900	$530,000
Rough rice ..... bushels..	160,000	200,000
Spirits turpentine ..... casks..	2,800	45,000
Rosin ..... barrels..	11,300	13,500
Ton timber ..... pieces..	300	1,500
Shingles ..... number..	1,700,000	15,000
Lumber ..... feet..	3,000,000	30,000
Wool ..... pounds..	50,000	10,000
Hides ..... do ..	10,000	1,100
Fish ..... do...	1,500	1,500
Total	.....	817,600

INWARD.

Fertilizers ..... tons..	4,300	$150,000
Groceries and provisions ..... do...	2,500	250,000
Estimated value of dry goods, boots, shoes, &c	.....	175,000
Total value of exports and imports	.....	1,392,600

"Of other inward freight, as well as cotton and other products shipped by river to railroad bridge, and thence by rail to Charleston, no accurate account can be given, as parties who control the steamers will not give the information.

"Very respectfully, yours,

"LOUIS S. EHRICH.

"REID WHITFORD, Esq.,
"*Assistant Engineer.*"

My thanks are due to Mr. Thomas S. Martin, overseer of this work, for the faithful and cheerful performance of his duty. The work has been done by hired labor and machinery, and material purchased in open market.

Very respectfully, your obedient servant,

REID WHITFORD,
Assistant Engineer.

Capt. W. H. BIXBY,
United States Engineer Office.

M 13.

IMPROVEMENT OF WATEREE RIVER, SOUTH CAROLINA.

The amount appropriated by the act of 5th July, 1884, together with the funds then available, was too small for economical work, but improvement was so much needed that small immediate actual results were regarded as more valuable than larger but delayed possible ones.

Owing to the experimental nature, its variable features, and the difficulty of properly specifying it beforehand and inspecting it afterward, the work was allowably done by hired labor and the purchase of materials in open market.

The special work of the year was as follows:

Between 7th November, 1884, and 15th April, 1885, the river was thoroughly cleared of its sunken, floating, and overhanging obstructions from its mouth 4.5 miles upward, and it was also roughly cleared of similar obstructions 40.5 miles farther to Camden, its head of navigation, 45 miles from its mouth. In this way 297 logs from 1 to 5 feet in diameter and from 20 to 90 feet in length, 63 stumps, 30 cords of small snags, and 2,533 square yards of rafts or floating material, were removed from the bed and channel of the river, and 385 trees were cut down and removed from the banks where they overhung and obstructed the navigation.

About 40 water-gauges were established at convenient locations along the river, and their dead low water readings were noted.

During the past year this work has been carried on with great vigor and thoroughness by Assistant Engineer R. Whitford, whose full report is appended.

The navigation of this river is obstructed at points, as shown by the following extract from special report, dated 17th January, 1885:

Eight miles above its mouth in the Santee, this river is crossed by the Camden branch of the South Carolina Railroad, on a wooden deck-bridge without a draw-span, the bottom of the bridge being 15.3 feet above low water.

The use of this bridge without a draw has been specially authorized, as far as concerns the State of South Carolina, by State acts passed in 1853 and 1858.

Thirteen miles above its mouth the river is also crossed by the Wilmington, Columbia and Augusta Railroad on a wooden deck-bridge without a draw-span, the bottom of the bridge being about 17 feet above low water.

The present improvement will probably be finished next year sufficiently to allow of a tolerably clear 4-foot navigation to steamers of 52 feet width over the whole river from its mouth up to Camden. The current of this river is swift and strong, especially during high-water stages. Both bridges have already proved serious obstructions to a desired navigation.

I therefore recommend that the owners of both these bridges be required to insert suitable draw-spans in their bridges; that the spans be at least 60 feet wide in the clear; that the openings be placed with reference to the deep water and the convenience of navigation; that the openings be provided with strong and suitable fenders on both ends of the span, extending, say, 150 feet above and 80 feet below the bridge, and that these fenders should rise above ordinary high water to within about a foot of the draw-span's lower chord.

Recommendations for future work are as follows: That this improvement be completed in accordance with the present approved and adopted project, so as to secure a thoroughly cleared 4-foot navigation over the entire river at all stages of water, at a total expense of $30,000, in addition to the $272.83 still available, to be appropriated in one sum during the next year. It is further strongly recommended that the Carolina Central Railroad and Wilmington, Columbia and Augusta Railroad be required to put draw-spans in their two low through bridges across the river. Further improvement, so as to extend the navigation above Camden, or to deepen that below Camden, is not recommended.

This river is in the collection district of Georgetown, S. C.

Money statement.

July 1, 1884, amount available	$161 81
Amount appropriated by act approved July 5, 1884	5,000 00
	5,161 00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	4,888 98
July 1, 1885, amount available	272 83
Amount (estimated) required for completion of existing project	30,272 83
Amount that can be profitably expended in fiscal year ending June 30, 1887	30,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

REPORT OF MR. REID WHITFORD, ASSISTANT ENGINEER.

GEORGETOWN, S. C., *June* 1, 1885.

CAPTAIN: I have the honor to make the following report upon the improvement of the Wateree River, South Carolina, during fiscal year up to date:

By agreement Mr. H. S. Cordes furnished a self-propelling steam hoister, and operations began at the mouth of the river 7th November, 1884, and continued under the

existing project, with some interruption on account of high water, finally stopping for the year 15th April, 1885, the appropriation having been expended.

At the outset the river was found to be badly choked with fallen timber, one layer upon another, and reaching nearly to the low-water surface, in many places snags appearing even above. It was thought best to clear a channel 80 feet wide, with a depth of at least 4 feet at dead low water, to a point as far up as might be reached—to the first railroad bridge, if possible; this for the convenience of the dead low water navigation of the river, giving connection all the year with railroad lines. In addition, to remove from the channel those obstructions most particularly interfering with the high-water navigation of the river from the upper limit of the thoroughly cleared low-water channel below to the town of Camden, the head of navigation above, and this to be done for the convenience of navigation during the flush-water period, when the water is not less than 3 feet above dead low water, which probably exists for nine months of the year.

With the foregoing in view the work was pressed with vigor under the recent appropriation, the following results having been accomplished at the time of suspension of operations:

The low-water channel was completed from mouth of river to a point 4.5 miles above, which is about 3 miles below first railroad bridge, Camden Branch of the South Carolina Railroad; and the overhanging trees were removed between mouth of river and a point 7.65 miles above, or about 3.15 miles above the completed dead low-water channel. The hoister afterwards proceeded to Camden, removing such obstructions as were most in the way during flush water, and returned over the same track, doing similar work to the second railroad bridge (Wilmington, Columbia and Augusta Railroad).

Following statement shows amount of work done for the season:

Removed from the river 297 large logs, 63 stumps, 29.75 cords snags, 2,533 square yards of drift, such as logs, brush, &c.

From the banks, 385 overhanging trees.

Operations have been carried on at intervals for the past several years upon this river, and as nearly as can be ascertained such portions were worked over from time to time, as given below:

Number.	Names of places.	Distance from mouth river.	Portions previously worked over.	Space thoroughly worked.	Space roughly cleared.
1	Mouth River	0	1882–1883?	Overhanging trees, 1884–1885. Logs, snags, and stumps, 1884–1885.	1885. Overhanging trees, logs, snags, stumps, &c.
2	Old River	1.35			
3	Dawson's Gut	3.35			
4	Old River	7.10			
5	South Carolina Railroad Bridge*.	7.65			
6	Obstructions for bridge†	12.35			
7	Wilmington, Columbia and Augusta Railroad Bridge‡	12.75			
8	Break Through§	13.85			
9	Bynum's Ferry‖	16.85			
10	Break Through	19.35	1883?		
11	Colonel's Creek	22.35			
12	Old Mill Race	23.35			
13	Old Mill Cut	24.35			
14	Cook's Landing	27.35			
15	English Landing	30.60			
16	—— Landing	45.35			
17	Arthur's Creek	47.60			
18	Anerimus' Ferry	47.85			
19	Moody Landing	49.60			
20	Kennedy's Old River	51.35			
21	Jordan's Landing	54.85			
22	Lang's Landing	59.10			
23	Clark's Landing	59.85			
24	Pine Tree Creek	62.85			
25	Camden¶	64.35			

* Bottom of bridge above dead low water, 18 feet.
† Rise and fall of water, about 11 feet.
‡ Bottom of bridge above dead low water, 21 feet.
§ Rise and fall of water, about 11 feet.
‖ Neither bridge is provided with draw openings.
¶ Top of bridge at Camden above dead low water, 35 feet.

REMARKS.—"Thoroughly cleared" means that boats of 4 feet draught can run day or night at dead low water. "Roughly cleared" means that same boats can run safely in daylight when there is a rise of 3 feet above dead low water. Top of bridge at Camden above dead low water, 35 feet. The distances given are only approximate and are subject to change, as the river may be measured in continuing the improvement.

The logs remaining in the river to be yet removed were taken account of from Camden down at the season of dead low water. This was done as accurately as possible, and an allowance was made for logs not seen, but supposed to be underneath those in sight, as is often the case by actual experience. Notwithstanding this there may be more logs than are accounted for in the following estimate, owing to the quantities of drift logs brought down by every freshet, which lodge against the old snags, and find a permanent resting place at the bottom. Aside from this only a few logs may be exposed above the bottom, but so soon as they are removed the sand becomes washed away showing others to be taken out.

As well as could be observed from a rapid examination there are about 10 miles of banks to be trimmed of the growth which is likely soon to fall in and obstruct the channel again.

Before any lasting improvement can be made in removing obstructions from the bed of this stream, it will, in my opinion, require a thorough clearing of growth from all caving banks, and protecting the same with proper dikes to prevent further wash. Because just so sure as there are freshets, certain portions of the banks will wash and cave under the weight of the heavy trees above, causing them to pitch forward into the river, forming new obstructions. A survey, or at least a careful examination, will be necessary to determine with accuracy the amount of this character of work to be done. Ten miles is mentioned as that needing immediate attention.

It must be borne in mind that while certain portions of the river are reported as being thoroughly cleared of obstructions at present, it is not by any means to be thought that it will remain so if left for months without any further work.

Even after the improvement is completed under the existing project, it will require the yearly expenditure of the small amount necessary to pay for the services of a hoister, the work of which will be to keep the channel free from obstructions. Unfortunately the last appropriation was so small that it did not admit of bringing the work to anything like a state of completion.

I would recommend a continuation of the same character of work as heretofore under the existing project until completed to Camden. To this, and the estimate of probable cost of finishing same, is respectfully submitted :

3,285 logs and stumps, at $8	$26,280 00
10 miles of river banks (250 large trees, at $1, and 1,000 small trees, at 10 cents), at $350	3,500 00
Total	29,780 00
General and local superintendence, per year, 10 per cent	2,978 00
Add 10 per cent. for contingencies	2,978 00
Total	35,736 00

In addition to the above a yearly appropriation of about $5,000 will be required, it is thought, to keep the river free from snags and drift.

The depth desired is about 3.5 feet at dead low water. The Wateree is naturally a deep stream, and there would be probably very little work necessary, besides removing logs to furnish this depth. This, however, can only be accurately determined by a careful survey of sand-bars.

There are doubtless a greater number of logs to be removed between the two railroad bridges than elsewhere at present. Higher up the river is comparatively open.

The first bridge, going up, is owned by the South Carolina Railroad Company. It is not provided with any draw opening. Trains run through it. Stone abutments at west end, wooden piers with a continuation of trestle-work at east end. Length of bridge proper, 420 feet. Bottom of bridge 18 feet above dead low-water level. The water rises and falls here about 11 feet in ordinary freshets.

The next bridge is owned by the Wilmington, Columbia and Augusta Railroad Company. It has no draw openings; trains run on its deck; stone abutments and piers. Length of bridge, 336 feet; height of bottom of bridge above dead low water is 21 feet. The rise and fall of the water in ordinary freshets is about 11 feet.

The next is a county bridge at Camden. Height of top of bridge above dead low water, 35 feet.

I respectfully send herewith a sheet* showing the profile of the rise and fall of water, as indicated on drawing. The gauge-readings were recorded by the time-keeper between mouth of river and Camden as work progressed between those points.

The Wateree drains a rich country in the cotton belt of this State. Much valuable timber is found therein, including walnut. The people are prosperous, cultivating large areas in cotton. The owners of pine lands are only waiting for transportation to be furnished via the river before going largely into the naval-store business. Much high-land rice is yearly produced.

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* Omitted.

The map of the State will show you what a convenience boats on the Wateree would be to much of the country in that vicinity.

The Wateree at its mouth meets the Congaree and forms the Santee River.

COMMERCE.

At present there is no commerce on the river. A small steamer capable of carrying about 300 bales of cotton has been within the past few days placed on the river by the South Carolina Steamboat Company. They will in all probability build up a large and paying trade. The prospective commerce for the first year of a line of boats running regularly on this stream would be about as follows, as well as could be ascertained:

OUTWARD FREIGHT.

Articles.	Quantity.	Value.
Cotton ..... bales ..	8, 000	$400, 000
Rosin ..... barrels ..	17, 000	54, 000
Spirits turpentine ..... do	4, 000	60, 000
Rice ..... bushels ..	50, 000	62, 500
Total	.....	576, 500

INWARD FREIGHT.

General merchandise ..... tons? (about) ..	10, 000	$400, 000

There would be also lumber, timber, shingles, &c., in large quantities, but for these no approximate figures can be arrived at. The commerce would increase from year to year timber as the boats come to run with fixed regularity.

During the dead low water period of last fall, forty water-guages were established on the river between Camden and its mouth, at proper intervals, with the zero of each at that water-level. We will thus be enabled to do no more work than necessary to keep to the desired depth at dead low water though the river might be rising.

A letter from Mr. Cordes, general manager of the South Carolina Steamboat Company, is herewith sent. It explains itself.

Work was done by hired labor and machinery, and supplies purchased in open market.

In connection with this work, I wish to add that Mr. E. C. Easterling, time-keeper of this work, has been prompt and efficient in the performance of his duties.

Very respectfully, your obedient servant,

REID WHITFORD,
Assistant Engineer.

Capt. W. H. BIXBY,
Corps of Engineers.

LETTER OF THE GENERAL MANAGER OF THE SOUTH CAROLINA STEAMBOAT COMPANY.

CHARLESTON, S. C., *June* 1, 1885.

SIR: In reply to your question as to whether the logs obstructing the channel of the Wateree River, South Carolina, have prevented our company running a line of steamers on that river or not, I have to say that in the present condition of the river so far as logs are concerned, I can see no reason why a boat drawing from 3 to 4.5 feet could not run with a sufficient degree of safety for from six to nine months out of the twelve, or during the flush water period from Camden down. I am convinced that the works previously accomplished by the United States Government has greatly improved this stream, which was so filled with logs as to render it impossible for boats to run, except only at high water. Even then it was dangerous.

Since we have seen that the Government shows a disposition to continue to improve the navigation on this river, we have become anxious to run a regular line of steamers of 350 tons each from Camden down. We firmly believe that the amount of freight which we would at once transport would encourage us to continue the boats and build up a paying trade.

The Wateree flows through a rich country, and we have every reason to believe that an important commerce could be soon built up. We are prevented from carrying

out our wishes in this respect by the existence of the two railroad bridges over the river, and both are without draws to admit of the free passage of boats.

We have recently placed a small low-built steamer on this river with the hope that she might be able to pass under the bridges, but I have just been notified that this boat is now at the railroad bridge unable to pass on account of a rise of 9 feet in the river. This does not give our boat clearance enough to pass under bridge, though we lower smoke-stack and remove pilot-house.

Very respectfully, yours,

H. S. CORDES,
General Manager, South Carolina Steamboat Company.

MR. REID WHITFORD,
Assistant Engineer.

M 14.

PRELIMINARY EXAMINATION OF NORTHEAST BRANCH OF CAPE FEAR RIVER, NORTH CAROLINA.

UNITED STATES ENGINEER OFFICE,
Wilmington, N. C., October 24, 1884.

SIR: I have the honor to submit the following report upon the Northeast Cape Fear River, in accordance with instructions contained in letters from your office, dated July 31 and September 4, 1884.

The instructions of your letters call for an examination preliminary to a "resurvey." This office does not possess any record nor information of any previous official survey, nor even preliminary examination of this river.

The examination of this stream was at first intrusted to Assistant Engineer W. H. James, who had formerly mapped the region himself while locating a common road and drain through this region and its neighboring swamp. Assistant Engineer James's sudden death occurred before he had time to submit his report.

The following report is submitted by myself, after a personal visit to the river, at three different points, and after a study of its maps, and after the collection of general information and statistics from various persons directly interested in its navigation.

The Northeast Cape Fear River is formed from several small creeks which rise in the north and east of Duplin County, and which join at Hallsville, in the center of Duplin County. The river then flows in a general southern direction about 120 miles to Wilmington, where it enters the Cape Fear River. In its upper portion it is about 12 miles distant from the Wilmington and Weldon Railroad; during the lower 90 miles of its length is never more than 6 miles away from this railroad.

From its mouth at Wilmington up 30 miles to Rocky Point the river, at low and medium water, is from 300 to 200 feet wide, and its channel is everywhere at least 60 feet wide and from 12 to 30 (average 15) feet deep at high tide; it has a rise and fall of tide of about 2 feet, and an alternate ebb and flood of about 2 miles per hour. At about 12 miles from Wilmington by water is the mouth of Long Creek, or Lillington River, upon which $6,000 was spent in 1882 and 1883, to give a depth of from 7 to 50 feet, and a width of from 45 to 500 feet over 11 miles of river from its mouth to Lillington. No regular line of boats of any kind are as yet running in return for the above improvement. Near Castle Hayne, about 18 miles from Wilmington by water, the river is crossed by the Wilmington and Weldon Railroad over a bridge without a draw, leaving under it a clear height of only 12 feet at lowest tide, 10 feet at high tide, and 8 feet during freshets.

From Rocky Point 30 miles more to Bannerman's Bridge, 60 miles from Wilmington, the Northeast Cape Fear River is still a stream of about 100 to 150 feet width and 6 to 30 feet channel depth at low tide, with 2 feet rise and fall of tide and an alternate ebb and flood of about 3 and 1 miles per hour.

At Bannerman's Bridge is a draw-bridge, said to be slightly out of repair.

From Bannerman's Bridge 12 miles more to Kroom's Bridge, about 72 miles above Wilmington, the river still retains its tidal character and a free depth of from 4.5 to 6 feet at all times of the year. Kroom's Bridge is also without a draw, obstructing navigation during the high-water season.

From Kroom's Bridge about 68 miles more to Hallsville, about 120 miles by water from Wilmington, the river becomes more narrow, crooked, shallow, and rapid, and loses entirely its tidal character. At low stages of water it is not navigable even for shallow flats; at medium stages it is occasionally navigable for boats of 20 inches draught; and during freshets it is easily navigable by such boats. This navigation is, however, further impeded by a bridge without a draw at Chinquepin, 12 miles below Hallsville.

Above Hallsville there is no navigation at all.

As far as can be at present learned, about 15,000 barrels of naval stores is all the freight that comes to the river above Kroom's Bridge; about 15,000 more barrels come to the river in the vicinity of Kroom's and Bannerman's bridges, and about 30,000 to 40,000 tons of stone from Rocky Point and its neigboorhood.

The navigation from Bannerman's Bridge down past Rocky Point to Wilmington is already so good that a small steamer with two small flats abreast, making a total width of about 40 feet, and an exterior draught of 2 feet, has had no difficulty in descending the river at night at a medium stage of water.

Various attempts have been already made to establish a line of steamboats upon this river. A small steamer of 38 tons, able to carry 250 barrels of naval stores, was run up to Bannerman's and Kroom's bridges twice a week for about two years, from about 1872 to 1874, and then given up because it did not pay. The same attempt was made for another two years, from about 1874 to 1876, and also given up, for the same reasons. Later still, another attempt was made with a still smaller boat, and also given up. This year the people near Bannerman's Bridge have tried to hire a small steamer to run there, but could only offer as inducements to its owner the promise of 150 barrels (23 tons) of naval stores per week.

It may appear at first sight surprising that so fine a river carries so little freight; but the country east of this river is almost all marshy and unproductive for several miles back from the river bank, while the country west of the river is crossed at an average distance of 4 to 5 miles by a good line of railroad running straight to the Wilmington market. Under these circumstances it is cheaper to send the stores to market by rail than to haul them several miles to the river bank to forward later by boat. It does not appear to me at all probable that the commerce of this river will increase to any great extent for many years to come.

The 30,000 tons and more of stone from Rocky Point is already being carried down by large tug-boats and large flats without the slightest difficulty except that due to the bridge near Castle Hayne, already alluded to. This bridge is a serious obstruction (and the only serious

obstruction) to an otherwise free navigation upon 42 miles of tidal river everywhere at least 6 feet deep.

It is not at all impossible that the line of inland navigation from Beaufort, N. C., to Wilmington will some day run through this neighborhood, and will then utilize a portion of this river; but until such day arrives this river is already improved far ahead of the demands of its commerce.

Under the above circumstances it is my opinion that at present the Northeast Cape Fear River is not worthy of improvement, and I see no good reason for any resurvey.

Very respectfully, your obedient servant,

W. H. BIXBY,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

PRELIMINARY SURVEY OF NORTHEAST BRANCH OF CAPE FEAR RIVER, NORTH CAROLINA.

UNITED STATES ENGINEER OFFICE,
Wilmington, N. C., February 14, 1885.

SIR: I have the honor to submit the following report upon a preliminary survey of the Northeast Cape Fear River, North Carolina, in accordance with instructions contained in letter from your office dated January 23, 1885.

My report of October 24, 1884, upon a preliminary examination of this river, stated that the Wilmington and Weldon Railroad Bridge at Castle Hayne, 18 miles from Wilmington by water, was a serious obstruction to its present navigation, that otherwise the river was already improved far ahead of the demands of its commerce, and that it was, therefore, not worthy of further improvement by the General Government. However, after that report was written I found that the river channel 2 miles from Wilmington, and just below the draw of the Wilmington, Columbia and Augusta Railroad Bridge, was partially and dangerously obstructed by the submerged piers of an old wagon bridge. The present survey, authorized by your office at my request, was made to determine the amount of these obstructions and the probable cost of their removal.

This report is accompanied by the following maps:

(1) A general map of the Northeast Cape Fear River and its surroundings (from United States post-office map of North Carolina), 1884; scale of $\frac{1}{500000}$.

(2) A detailed map of the submerged piers and the neighboring river, 1885; scale of $\frac{1}{12000}$.

The survey was intrusted to Assistant Engineer Charles Humphreys, whose report and map are herewith appended.

The bridge to which these piers belonged was destroyed over twenty-five years ago, and very few persons can remember ever having seen it. Two of these submerged piers are directly below the draw-span of the bridge and exactly in the desirable ship-channel. They are about 10 feet wide, 30 feet long, and consist of a wooden crib-work filled with loose rubble or stone ballast. One pier rises to within 7 feet of low-water level; the other rises fully to low-water level. Both piers interfere seriously with proper use of the bridge-draw, and both are dangerous obstacles to navigation.

The removal of these obstructions is very desirable; if done thoroughly, as recommended by Mr. Humphreys, it may cost as much as $700.

With reference to the upper portion of the Northeast Cape Fear River, I have to submit herewith a report upon its commerce handed to me too late to be included in my report of October 24, 1884. This report indicates a commerce somewhat in excess of that shown by my own report; but the increase is not sufficient to justify me in changing my previously expressed opinion.

Under the above circumstances, I have therefore to recommend $700 as an amount that can profitably be expended upon the improvement of the Northeast Cape Fear River by the removal of the obstructions due to the sunken piers of the old bridge about 2 miles above Wilmington.

Very respectfully, your obedient servant,

WM. H. BIXBY,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.
(Through Lieut. Col. W. P. Craighill, Supervising Engineer.)

[First indorsement.]

UNITED STATES ENGINEER OFFICE,
Baltimore, Md., February 19, 1885.

Approved and respectfully forwarded to the Chief of Engineers.

WM. P. CRAIGHILL,
Lieut. Col. of Engineers.

REPORT OF MR. CHARLES HUMPHREYS, ASSISTANT ENGINEER.

WILMINGTON, N. C., *January* 31, 1885.

CAPTAIN: I have the honor to forward herewith the map of the Northeast Cape Fear River, near the Wilmington, Columbia and Augusta Railroad bridge, as ordered by your letter of January 3, showing "old piers" in channel of draw.

Pier No. 1 is a crib of square timbers, drift bolted together. The top of the pier is about at mean low-water level, and is about 10 feet by 30 feet. From about 8 feet below mean low water on down it is filled with small rock.

Pier No. 2 is about 7 feet below mean low water, and is composed of timber and stone.

I think Piers Nos. 1 and 2 should be removed to about 12 to 15 feet below mean low-water level, a red spar buoy placed on Pier No. 3, and also some of the old piles below the Ferry Landing should be removed.

I estimate this work to cost about $600 to $700, perhaps less.

The draw-fender pier is becoming rotten. In case it should be rebuilt it would be an improvement to navigation if its direction was parallel to the thread of the current.

Very respectfully, your obedient servant,

CHARLES HUMPHREYS,
Assistant Engineer.

Capt. W. H. BIXBY,
Corps of Engineers, U. S. A.

REPORT OF PRODUCTIONS OF THE COUNTRY ADJACENT TO THE NORTHEAST CAPE FEAR RIVER.

WILMINGTON, N. C., *October* 28, 1884.

Castle Hayne, 22 miles from Wilmington, is about one-half of a mile above the Wilmington and Weldon Railroad Company's bridge. This bridge is quite a serious obstruction to navigation, especially in times of high water. Steamboats are obliged to lower their smoke stacks, and in some instances wait for low tide, to pass their pilot houses under the bridge.

I learn that the shipments from Castle Hayne consist of peanuts, cotton, crude turpentine, tar, shingles and fire-wood, but could not obtain reliable information as to

quantity. Sturgeon Creek, 24 miles; Island Creek, 27 miles; and Harrison's Creek, 29 miles, each helps to swell the aggregate of shipments.

At Rocky Point, or Lewis's Ferry, 30 miles from Wilmington, the Messrs. French have, for several years, been quarrying limestone rock, working sometimes 500 hands, and employing a steam-tug and several lighters in transporting the rock to Federal Point Inlet. They also have a lime-kiln and make several grades of lime suitable for building and agricultural purposes; their band-making machinery, cotton-gin, and mill for grinding phosphate rock is run by steam-engine. A new lime-kiln of increased capacity is soon to be erected, and the apparently inexhaustive quantity of the rock, with the energy and business tact of proprietors, indicate that Rocky Point is destined to become an important factor in the commercial prosperity of this section. Those gentlemen also have a large farm, whereon they grow cotton, peanuts, corn, potatoes, fruit, &c. A few miles above Rocky Point the river has left the original channel and cut out through the swamps a thoroughfare, which is about two-thirds the width of the river and very deep. This thoroughfare is about 3 miles shorter than the old river, and is used by boats of 100 feet length successfully, though it is very crooked.

Bannerman's Bridge, 55 miles from Wilmington, is an important shipping point. Holly Shelter Creek comes in here, and the products of three turpentine stills, amounting to 12,000 barrels of rosin and spirits and 1,500 barrels of crude turpentine, are shipped down this creek; 1,540,000 feet of cypress timber, 200,000 feet of pine, and 100,000 shingles are part of the shipments from Holly Shelter Creek. The tide rises at Bannerman's Bridge about 2 feet. The depth of water is said to be sufficient to allow a boat drawing 6 feet to come to Bannerman's at all seasons.

Kroom's Bridge, 75 miles, is the beginning point of a canal that is proposed to be cut by convict labor, furnished by the State of North Carolina, for the purpose of draining Angola Bay, in which bog it is estimated there are 60,000 acres of land, which will become very valuable for agricultural purposes. In this swamp there are large quantities of valuable timber. There is 6 feet of water at Kroom's Bridge at all seasons. South Washington, 5 miles above Kroom's, is at the head of tide-water navigation, and 3 miles east of the Wilmington and Weldon Railroad. From this point down to Bannerman's the railroad absorbs most of the freight which would go by the river if shipping facilities were afforded.

Above South Washington shoals occur frequently. At present the depth of water on shoals would not be 1 foot. These shoals are supposed to be caused by logs and other obstructions in the channel. Between shoals the water is in many places 10 to 15 feet. It is thought that the removal of the logs would cause the river to work out to such an extent that many thousand acres of swamp lands could be successfully drained and cultivated. From Kroom's Bridge to Chinquapin, estimated at 75 miles, the river is navigable for light-draught flat-bottomed steamers about eight months of the year. The flats which carry the products of the upper part of the river are often loaded down to a draught of 2.5 feet. Shoals generally have about 3 feet water. The current is strong, indicating a good deal of fall to the river.

At Hallville I found three stores. The shipments amount to 9,000 barrels of rosin, 1,000 barrels of spirits, 2,000 barrels of tar, 240 bales of cotton, 60,000 pounds of dog tongue, 100,000 feet of timber. Above Hallville the river becomes more shoaly, and flats can only go in time of freshets to Sarecta, 20 miles, and Kornegay, 40 miles. There are a good many landings that I could not visit in the time I had at my disposal, and several of the gentlemen to whom I was referred as capable of giving reliable information were away from home. Had I succeeded in finding them the aggregate would be largely increased.

The aggregate amount of freight shipped from the points visited is as follows, and it is highly probable that with increased facilities this amount would increase a hundred fold.

Aggregate amount of annual shipments on Northeast Cape Fear River.

Articles.	Quantity.	Articles.	Quantity.
Spirits turpentine ..... barrels..	5,200	Cotton ..... bales..	900
Rosin ..... do...	46,000	Shingles	500,000
Tar ..... do....	4,000	Staves (not estimated)	.....
Turpentine (crude) ..... do....	8,000	Timber (cypress) ..... feet..	1,540,000
Corn ..... bushels..	2,500	Timber (pine) ..... do ...	2,000,000
Potatoes ..... do...	1,000	Dog tongue ..... pounds..	208,000
Rice ..... do....	300	Pork ..... do...	5,000
Peas ..... do....	200	Chickens, eggs, hides, tallow, beeswax, furs, &c.	$6,000
Peanuts ..... do....	500		

Respectfully submitted.

D. M. O'HANLON.

M 15.

PRELIMINARY EXAMINATION OF BOGUE SOUND, BETWEEN NEW RIVER AND BEAUFORT, NORTH CAROLINA.

UNITED STATES ENGINEER OFFICE,
Wilmington, N. C., October 24, 1884.

SIR: I have the honor to submit the following report upon a preliminary examination of Bogue Sound, between New River and Beaufort, N. C., in accordance with the instructions contained in letters from your office dated 31st July and 4th September, 1884.

No detailed personal examination of the entire sound was deemed necessary, because such examination has been already made (see examination of Bogue Sound to New River, pages 36,37, Ex. Doc. No. 30, Senate, Forty-eighth Congress, first session; and of White Oak River, see pages, 1, 113–114, I 22, Annual Report Chief of Engineers for 1882; and of New River, see pages 1, 117–119, I 24, Annual Report of Chief of Engineers for 1882), and because I had been able to consult a tracing of a recent Coast Survey map of the whole sound, constructed to a scale of about 3 inches to the mile. For these reasons my examination was confined to visiting only one end of Bogue Sound proper, and to studying the character of the sound by a visit to other similar but more convenient localities, checking such study by reference to the Coast Survey map above alluded to. In order to get further details as to the commerce of the sound, I sent Assistant Engineer R. Ransom to Swansborough and New River for that special purpose, his report being appended herewith.

Bogue Sound proper extends from Beaufort Harbor westward about 24 miles to White Oak River, opposite Bogue Inlet. It is generally from 1 to 3 (average 2) miles wide, and generally from 2 to 20 (average 3 to 4) feet in depth, with at least 3 feet depth in the main channel. There is, however, about 3 miles of shoal, where the water is only about 2 feet deep at low water. The average rise and fall of the tide is about 1.5 feet. One of the proposed routes of inland navigation from Beaufort Harbor to Wilmington passes through the whole length of the sound.

Boats drawing 5 feet of water can enter Bogue Inlet from the ocean and go nearly 2 miles, to Swansborough, a town of over 500 inhabitants, and about 3 miles farther up White Oak River. Boats drawing but 3 feet can go 15 miles farther. The most of the produce from White Oak River and Swansborough is, however, carried to Beaufort Harbor by small boats through the *sound*, in order to avoid an ocean journey, and it is said that a small light-draught steamer is shortly to run between these two places. The shipments from this locality at present are about 20,000 barrels of naval stores, 3,000 bales of cotton, 4,000 barrels of peanuts, and 15,000 barrels of fish. The forests of White Oak River are able to furnish large amounts of lumber.

Bogue Sound proper ends at White Oak River and Bogue Inlet, but is continued about 17 miles to New River by a narrow, crooked, tide-water creek zigzagging through marshes from 1 to 2 miles wide and with from 8 to 24 (average 12) inches depth of water overlying its soft mud bottom. One of the proposed routes of inland navigation from New Berne to Wilmington extends from Swansborough through this marsh land to beyond New River.

Boats drawing 5 feet of water can enter New River Inlet from the ocean and go nearly 20 miles up New River to a point about 3 miles above Onslow (Jacksonville), a town of about 1,000 inhabitants, the

county-seat of Onslow County. This navigation is partially obstructed by the existence of only a 50-foot width of crooked channel through nearly 7,000 feet length of oyster rock. Ten thousand dollars was appropriated this year to widen this cut, but no work is being done here at present, because such work cannot be carried on here with advantage until $20,000 is available. The annual shipments (either by wagon or by boat) from this locality are at present about 4,500 bales of cotton, 35,000 bushels of rice, 50,000 bushels of corn, 10,000 bushels of peanuts, 100,000 barrels of naval stores, 50,000 barrels of fish, and large quantities of oysters, for which this river is famous. Nearly 40,000 acres of oyster farms and large forests of timber are available for use. Their proper development is delayed because of lack of easy and free transportation to market. An appropriation of $15,000 more for New River, a work already decided to be "worthy of improvement," will open this river freely to the ocean, and will afford a free passage for small boats to Beaufort and Wilmington, the nearest markets. It would, however, require a canal nearly 25 miles long, dredged to at least 100 feet width and 3 feet depth, at a cost of at least $200,000, to afford a free passage to similar small boats through the sound from New River to White Oak Inlet.

As the "inland line of navigation" now extends from New Berne to Beaufort, N. C., it will undoubtedly be further extended from Beaufort toward Wilmington. In such case the whole extent of the sound from Beaufort Harbor to New River will require a careful survey, but such a survey is not needed until then.

In my opinion Bogue Sound from White Oak River to New River cannot be improved except at a cost far exceeding that demanded to-day by the present and prospective commerce, and is therefore to-day "not worthy of improvement."

At the same time it is my opinion Bogue Sound from Beaufort Harbor to White Oak River is worthy of improvement for the benefit of White Oak River, provided that such improvement is moderate in cost. Owing to the extent of territory and the shifting nature of the channel bottom, such approximate cost of improvement cannot be determined without recourse to a survey, or at least to a more extended examination than my present funds allow. An extended examination of sufficient accuracy to determine such cost can probably be made for $600. A survey sufficiently accurate to determine such cost, and also to serve as basis for a project for such moderate improvement, can probably be made for $1,000, including the project and estimates of cost of improvements proper to be made.

Very respectfully, your obedient servant,

W. H. BIXBY,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

REPORT OF MR. R. RANSOM, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
New Berne, N. C., October 20, 1884.

CAPTAIN: In compliance with your instructions, dated the 15th instant and received by me the 16th instant, I have the honor to make the following report of "preliminary examination" required thereby:

Bogue Sound extends from Beaufort Harbor to Swansborough, about 25 miles. At the latter place enters White Oak River, a stream washing up into the counties of Onslow and Carteret, and navigable for a considerable distance; but my time was too

limited to make an examination. From Swansborough are shipped now about $40,000 of naval stores annually, with no probability of an increase; 2,500 to 3,000 bales of cotton, 3,000 to 5,000 bushels of peanuts, 15,000 barrels of salt fish, besides many fish sent to Beaufort and Wilmington.

On White Oak River are large quantities of pine, oak, cypress, and other timber, the forest being yet but little pillaged.

The sound between Beaufort and Swansborough is open, The Coast Survey maps are more full than any report I can make.

Between Swansborough and New River, navigation by the east-bound or inland route is impracticable now except by very small boats at high tide. Perhaps one-twentieth of the valuable arable land is cultivated. This does not include large tracts not susceptible of cultivation, but producing timber.

New River is now navigable for about 35 miles for craft of 4 or 5 feet draught, but under difficulties. Three-quarters of a mile below Jacksonville the stream is 1½ miles wide, and opens to about 5 miles at its mouth, 20 odd miles below. Above Jacksonville the stream is comparatively narrow and can hardly be made navigable for more than 12 or 15 miles higher up. The main obstructions to vessels drawing 8 or 10 feet of water are the bar at the mouth and small shoals in a few places above, together with logs, &c. Tide-water reaches up 25 miles above the bar to Jacksonville, or just below.

About 4,000 to 5,000 bales of cotton, 30,000 to 40,000 bushels of rice, 50,000 bushels of corn, 10,000 bushels of peanuts, 100,000 barrels of naval stores, 50,000 barrels of fish, and a large quantity of fish and oysters are annually shipped and hauled from the lands and waters of New River. About one-fifteenth to one-twentieth of the available land is covered by large districts of primitive forests whose timber is almost untouched. Excepting the naval stores all these products would probably quadruple in quantity in a few years if proper egress could be found for them.

This region is untapped by railroads, and almost everything that is sent to market goes by wagons from 25 to 50 miles.

I deem the river especially "worthy of improvement," for the fact that it penetrates an exceptionally productive country which is but little developed, and which has no other means of sending its produce with facility to market. Large forests of oak timber, almost untouched, lie upon its banks and in near proximity. Some of the best natural fisheries in the State are here, and 35,000 to 40,000 acres of oyster waters, equal to any in the world and famous locally, await cultivation and development. Six years' experience in this region, upon the Neuse, the Trent, and the Contentnia rivers, convince me that New River would increase its shipments, and the country bordering it improve in quite as rapid proportion as the above-named streams, perhaps in even greater degree.

Accompanying this report is an estimate for a detailed survey of New River, which may be greater than needed; but I am satisfied that good economy requires careful and full surveys upon which to base projects for further work.

ESTIMATE FOR THE SURVEY OF NEW RIVER.

Engineer or surveyor in charge of party, one month	$150
Assistant surveyor in charge of party, one month	100
One living-boat, manned for party, one month	150
Eight laborers, assistants, &c.; 4 at $40, $160; 4 at $30, $120	280
Provisions for 12 men, one month	120
Sundries and contingencies	100
	900

Very respectfully, your obedient servant,

R. RANSOM,
Assistant Engineer.

Capt. W. H. BIXBY,
Corps of Engineers.

SURVEY OF BOGUE SOUND, BETWEEN NEW RIVER AND BEAUFORT, NORTH CAROLINA.

UNITED STATES ENGINEER OFFICE,
Wilmington, N. C., February 2, 1885.

SIR: I have the honor to submit herewith my report upon a survey of Bogue Sound between New River and Beaufort, N. C., in accordance with

instructions from your office dated 21st July, 4th September, and 21st November, 1884.

This report is accompanied by the following maps:*

1. A general map, drawn to a scale of 1 inch to 8 miles, showing the general surroundings of Bogue Sound (from United States post-route map of North Carolina.)

2. A copy of the United States Coast Survey Charts of Bogue Sound, from Beaufort Harbor to New River (in seven sheets). Scale $\frac{1}{20000}$.

3. A tracing showing the proposed channel through Bogue Sound from Beaufort Harbor to White Oak River (Bogue Inlet), with the depth of water in the vicinity of this channel (in five sheets). Scale $\frac{1}{20000}$. (Surveyed by John P. Darling.)

My report of 24th October, 1884, on a preliminary examination of this locality gives fully its general physiographical and commercial statistics; and explains why the present survey was limited in extent to the eastern half of Bogue Sound, extending from .Morehead City to (Bogue Inlet) White Oak River.

Since that report was written I have come across some other information upon Bogue Sound, especially between Swansborough and New River, in an old report of Mr. S. T. Abert, made in 1876 (see pages 25 to 28, Senate Ex. Doc. No. 35, Forty-fourth Congress, first session), from which I quote the following:

> From Bogue Inlet to Cape Fear River the sand-banks—the only barrier between the sounds and the ocean—become much lower and narrower. In times of storms the waves are dashed over and through them by the hurricanes, the sand is carried by sea and wind into the sounds, deposits are made at the meeting points of the tides from the numerous inlets with which the coast is indented, and communication at mean tide, even, is often closed. The bars and shoals become the bases of salt marshes, and their accumulation, which is progressive, encroaches upon the channels, and year by year they are becoming closed. From Swansborough, following the channel to the west of Hoggins' and Dudley's Islands, a depth of 8 feet can be obtained as far as to the entrance of South Cow Channel, the only entrance at low water communicating with succeeding sloughs leading to New River Inlet. An extensive shoal bars this entrance, save a very narrow passage running between its northern point and the adjacent marsh. Through this passage, and for three-fourths of a mile, only 3 to 7 feet of water is found, but the remainder of the distance to Bear Inlet, $2\frac{3}{4}$ miles, carries a depth of from 8 to 14 feet. The depth of water over the bar at Bear Inlet at low water is 5 feet. The tide rises 4 feet. From Bear Inlet the Bank Channel is wide and straight for a distance of $1\frac{3}{4}$ miles, with a depth of between 7 and 8 feet. Here the communicating slough becomes narrower and tortuous, the islands become more numerous, and the depth of water varying at nearly every cast from 2 to 8 feet until Brown's Inlet is reached. The bottom is as changeable as the depth, being either hard sand, soft sand, mud, or oyster-rock. There is no channel over the bar at Brown's Inlet. The shoals within have changed and increased a great deal since the former survey. The tide rises 5.5 feet at the inlet, but this rise decreases rapidly as we pass into the creeks. It was stated by an old fisherman met here that to his knowledge the banks had washed back 50 yards in the past twenty-five years, the distance being determined by some trees felled by his father which had never been moved. Also, that the depth of the water in the creeks had decreased some 2 feet in the last ten years. He remembered a storm that had swept the sea over the banks and inundated, not only the marshes, but also the mainland, and for some distance back. The banks here become extremely low and narrow, the distance to the mainland less, and the continuous slough so intercepted by others, and so circuitous and narrow (at places barely 10 feet in width), that the finding of a continuous channel is a difficult task. To the meeting point of the tides, called "The Crooks," $2\frac{1}{2}$ miles from Brown's Inlet, the depth varies from 2 to 5 feet. From the sand-bar—bare at low water—formed here, the depth varied from zero to 2 feet to nearly the northerly point of New River Inlet. The depth of water over the bar, from the quicksand formation, varies considerably as the wind prevails from different directions. It has been known to have been cut out to a depth of 15 feet under the influence of a northeast storm, but to return in a few days to its mean depth. At the time of the examination an extremely low tide, 3.5 feet, was found. The rise and fall of the tide at the inlet was 1.8 feet.

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*Omitted.

Combining this description with the information derived from the Coast Survey map, we find that at least a 3-foot channel exists over about one-half the way from White Oak River to New River. Allowing for the existing channel, but allowing also for the height (2 feet) of the top of the marsh above low water, we obtain the following estimates for channel-ways of different cross-section from White Oak River to New River, a distance of about 80,000 feet.

For a channel of 3 feet depth at low water, 30 feet bottom width and 40 feet top width, 260,000 cubic yards, at 30 cents, $78,000.

For a channel of 4 feet depth at low water, 30 feet bottom width and 40 feet top width, 360,000 cubic yards, at 25 cents, $90,000.

For a channel of 5 feet depth at low water, 30 feet bottom width and 40 feet top width, 470,000 cubic yards, at 25 cents, $117,500.

For a channel of 9 feet depth at low water, 80 feet bottom width and 100 feet top width, 2,700,000 cubic yards, at 20 cents, $540,000.

To these estimates may be added that of Mr. S. T. Abert, in his report of 1876 (page 28, Sen. Ex. Doc. No. 35, Forty-fourth Congress, first session), which is that a channel of 40 feet bottom width, 8 feet depth, and side slopes of 1 on 2 from Swansborough to New River, will require 2,051,456 cubic yards, at 30 cents, $615,436.80.

Similar estimates have been made later by Mr. F. W. Frost, in 1878–'79 (see page 895, Annual Report of the Chief of Engineers for 1880), in which he suggests the further necessity of a protecting dike along a portion of this distance, to cost $2.50 per linear foot.

In connection with these estimates, it is perhaps as well to state that the time and funds at my disposition for examinations and surveys were insufficient for any thorough new survey of this part of the sound; if such a survey be desirable, it cannot be properly made for less than $800.

With these new estimates before me, I still hold to my previously-expressed opinion, that since New River has already an outlet to the Atlantic through New River Inlet, the sound from White Oak River to New River cannot be improved except at a cost far exceeding that demanded by its present and prospective commerce, and is therefore to-day not worthy of improvement by the General Government.

The general charge and superintendence of the survey from Beaufort Harbor to White Oak River (Swansborough) was intrusted to Assistant Engineer R. Ransom; the survey itself was made by Assistant Engineer John P. Darling, whose report is hereby appended.

* * * * * * *

The report of Assistant Engineer Darling, condensed but full, shows that the present obstructed navigation from Beaufort Harbor to Swansborough (White Oak River) can be improved so as to have a clear channel at ordinary low water at costs in round numbers as follows:

A channel 100 feet wide and 3 feet deep	$6,000
A channel 100 feet wide and 4 feet deep	32,000
A channel 100 feet wide and 5 feet deep	62,000

After a full consideration of the reports of the present survey and of previous examination, checked up by a slight personal knowledge of the locality, I think that the channel should be at least 100 feet wide. All the shoals along the line of the proposed channel seem to have occupied their present position without serious change since the first examinations for improvement. The tidal currents from the two ends of the sound, changing their places of meeting with the changing winds, will quite probably be sufficient to keep open a narrow channel, if the latter is once dredged to a full width of 100 feet. On account of the

narrowness of the main boat-channels, and the shallowness of the rest of the sound, it will be necessary to go a long ways to find a place of deposit for the dredged materials. For this reason, as well as for those given by Mr. Darling, I think his estimates are none too high.

A steamship company has for some time had a light-draught steamer ready to make regular trips upon this sound as soon as the channel should be completely opened. I think that the interests of this comparatively rich but so far unopened country deserve assistance, *at least* as far as the establishment of a permanent 3-foot channel as far as Swansborough.

I have, therefore to recommend at least $10,000 as an amount that can profitably be expended during the coming fiscal year for the establishment by dredging of a continuous channel of at least 3 feet depth at ordinary low water through Bogue Sound, from Beaufort Harbor to Swansborough.

Very respectfully, your obedient servant,

W. H. BIXBY,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

REPORT OF MR. JOHN P. DARLING, ASSISTANT ENGINEER.

WILMINGTON, N. C., *January* 26, 1885.

CAPTAIN: I have the honor to submit the following report, with accompanying map (5 sheets) of the survey of Bogue Sound, North Carolina, from Newport River to the White Oak River, made in accordance with your instructions.

The field work of the survey was commenced December 23, 1884, and completed January 14, 1885. On account of the limited amount of money at my disposal, and the very unfavorable weather met with during the progress of the survey, it could not be made as extended and complete as desirable; but enough information was obtained upon which to base a plan of improvement and estimates for the same. The length of the sound between Newport and White Oak rivers is about 24 miles, and its width from 1 to 3 miles. The greater part of the survey was made by triangulation, and the soundings located by two instruments from stations on the shore; the topography was taken from the Coast Survey map (1864–'73).

All distances are measured from the railroad wharf at Morehead City.

The principal obstructions to navigation are two shoals called Sally Bell Shoal and Goose Creek Shoal.

Sally Bell Shoal is about 5 miles from Morehead City; it is 1,000 feet long and in the shoalest places has but 2.2 feet of water at average low water; the shoal is of sand, and appears to be a sort of bulkhead across the channel.

Goose Creek Shoal commences at the 13th mile and extends for about 8 miles, or nearly to the entrance of Burthen Channel at the Marshes. This is also a sand shoal, but with a thin covering of mud from 2 to 4 inches deep, and grass growing over the greater part of it. Goose Creek Shoals are cut up by many small sloughs, but the main channel follows along the mainland, and has in the shoalest places 2 feet of water at average low tide, but after several days of strong westerly winds the tides get very low, possibly from 0.5 to 1.0 foot lower than the average.

Through the Marshes, which commence about the 21st mile, there are 2 channels—Bank, which follows the general course of the banks, and Burthen, which follows the mainland.

As Burthen Channel is much the better of the two, I have made my estimates by that route and Cross Stakes Slough, which branches off from Burthen Channel, and shortens the distance considerably. The only obstruction in Cross Stakes Slough is at its entrance, where a little dredging would be required.

All the improvement required on Bogue Sound is the dredging of a channel through Sally Bell and Goose Creek Shoals and a little dredging at the entrance to Cross Stakes Slough and in Hoggin's Island Channel.

I have made the following estimate for a channel 100 feet wide and 3, 4, and 5 feet deep. The reason for the difference, per cubic yard, in cost of dredging is the much larger area to go over to get the same number of cubic yards in the 4 and 3 foot channels.

Estimate for a channel 100 *feet wide and* 3 *feet deep.*

Number of cut.	Miles from Morehead City.	Length of cut.	Average depth.	Number of cubic yards.	Kind of material.	Cost per cubic yard.	Total cost.
1	*5.0	300	0.8	888.8	..Sand.....	$0 40	$355 52
2	15.5	250	0.1	92.6	....do.....	40	37 04
3	16.2	4,825	0.3	5,361.1	....do	40	2,144 44
4	17.5	700	0.2	518.5	.. do	40	207 40
5	18.0	2,200	0.5	4,074.0	....do	40	1,629 60
6	20.9	800	0.5	1,481.5	....do	40	592 60
							4,966 60
Add 15 per cent. for superintendence							744 99
Total							4,711 50

* Sally Bell Shoal.

Estimate for a channel 100 *feet wide and* 4 *feet deep.*

Number of cut.	Miles from Morehead City.	Length of cut.	Average depth.	Number of cubic yards.	Kind of material.	Cost per cubic yard.	Total cost.
1	*5.0	300	1.8	2,000.0	..Sand.....	$0 25	$500 00
2	13.6	2,300	0.5	4,259.3	....do	25	1,064 80
3	14.7	700	0.3	777.7	....do	25	194 44
4	15.2	2,300	0.5	4,259.2	....do	25	1,064 80
5	15.7	9,900	1.4	51,333.3	....do	25	12,833 33
6	17.5	2,550	0.6	5,666.6	....do	25	1,416 66
7	18.0	2,900	1.3	13,962.9	....do	25	3,490 74
8	18.6	2,400	1.0	8,888.8	....do	25	2,222 20
9	19.0	1,500	0.4	2,222.2	....do	25	555 55
10	19.3	1,400	0.5	2,592.6	....do	25	648 15
11	19.5	350	1.0	1,296.3	....do	25	324 07
12	19.6	3,700	1.0	13,703.7	....do	25	3,425 92
13	20.2	1,000	0.5	1,851.8	....do	25	462 95
14	20.9	800	1.5	4,444.4	....do	25	1,111 11
							29,314 72
Add 10 per cent. for superintendence							2,931 47
Total							32,246 19

* Sally Bell Shoal.

Estimate for a channel 100 *feet wide and* 5 *feet deep.*

Number of cut.	Miles from Morehead City.	Length of cut.	Average depth.	Number of cubic yards.	Kind of material.	Cost per cubic yard.	Total cost.
1	*5.0	300	2.8	3,111.1	..Sand.....	$0 20	$622 22
2	5.0	700	0.6	1,555.5	....do	20	311 10
3	9.7	4,000	0.7	10,370.4	....do	20	2,074 00
4	10.5	900	0.3	1,000.0	....do	20	200 04
5	12.2	2,000	0.3	2,222.2	....do	20	444 46
6	13.0	7,000	0.8	20,740.7	....do	20	4,148 18
7	14.3	4,600	0.7	11,925.9	....do	20	2,385 17
8	15.2	2,300	1.5	12,777.7	....do	20	2,555 55
9	15.7	9,900	2.4	88,000.0	....do	20	17,600 00
10	17.5	2,550	1.6	15,111.1	....do	20	3,022 22
11	18.0	2,900	2.3	24,703.7	....do	20	4,940 74
12	18.6	2,400	2.0	17,777.7	....do	20	3,555 55
13	19.0	1,500	1.4	7,777.7	....do	20	1,555 55
14	19.3	1,400	1.5	7,777.7	....do	20	1,555 55
15	19.5	350	2.0	2,592.5	....do	20	518 50
16	19.6	3,700	2.0	27,407.4	....do	20	5,481 48
17	20.2	3,500	0.7	9,074.1	....do.....	20	1,814 82
18	20.9	900	2.5	8,333.3	....do.....	20	1,666 66
19	(†)	1,700	1.0	6,296.3	....do	20	1,259 26
20	23.8	350	0.5	648.1	....do	20	129 62
21		500	0.8	1,481.5	....do	20	296 28
							56,136 95
Add 10 per cent. for superintendence							5,613 69
Total							61,750 64

* Sally Bell Shoal. † Cross Stakes Slough, Hoggin's Island.

Very respectfully, your obedient servant,

JNO. P. DARLING,
Assistant Engineer.

Capt. W. H. BIXBY,
Corps of Engineers, U. S. A.

M 16.

PRELIMINARY EXAMINATION OF CONGAREE RIVER, SOUTH CAROLINA.

UNITED STATES ENGINEER OFFICE,
Wilmington, N. C., October 26, 1884.

SIR: I have the honor to submit the following report upon the preliminary examination of the Congaree River, South Carolina, in accordance with instructions from your office dated 31st July and 4th September, 1884.

This examination was intrusted by me to Assistant Engineer Reid Whitford, whose report is appended.

The Congaree River is formed by the meeting of the Broad and Saluda rivers about 1 mile above Columbia, S. C., and flows southeasterly about 60 miles by water (30 by land) until it unites with the Wateree to form the Santee River.

The Santee River, now under improvement, will eventually afford at least a 5-foot navigation from Georgetown Harbor, through Mosquito Creek up, 184 miles, to the mouth of the Congaree River.

From the Santee River up about 57 miles, to within 3 miles of Columbia, the Congaree River has a width of from 500 to 300 feet, a depth of about 4 feet at low water, and a moderate current. Steamers of 4-foot draught formerly ran all the way up to this point from the sea-coast, but such navigation is now prevented by logs, snags, fallen timber, and overhanging trees.

From 3 miles below Columbia up to Columbia, the Congaree has a little less depth, a little more width, a little more current, and is more obstructed by rocks; probably a 3-foot navigation could be obtained without very great difficulty.

From Columbia, up 2 miles to the head of the Wateree, a slackwater navigation is already under construction by the State, to connect the city to Broad River, which latter brings down to Columbia a large quantity of flat-boated freight.

If the Congaree River were opened to navigation it would probably receive over 130,000 tons of freight per year.

Under the above circumstances this river is, in my opinion, worthy of improvement. A survey sufficiently accurate to serve as basis for the project of improvement can probably be made for $1,600, including the projects and estimates of cost of improvements proper to be made.

Very respectfully, your obedient servant,

W. H. BIXBY,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

REPORT OF MR. REID WHITFORD, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Georgetown, S. C., October 24, 1884.

CAPTAIN: I have the honor to report as follows upon the examination of the Congaree River made in compliance with instructions contained in your letter of October 15, 1884.

The Congaree has its head at the confluence of the Broad and Saluda rivers, at the city of Columbia, the capital of the State; flowing thence in a southeasterly direction, for 50 to 60 miles, it mingles its waters with that of the Wateree River, and thus forms the Santee River. The Congaree River is crossed at the foot of Gervais street, Columbia, a mile or more below its head, by a through wooden toll-bridge for vehicles, hav-

ing ten spans resting on stone abutments and piers, having total length of 1,357 feet, with floor 36 feet above dead low-water level. The river at this point is over 600 feet wide. Between the head of the river and this bridge there are a number of abrupt falls in quick succession filled with rock ledges and heavy bowlders, over which the water runs very swiftly, and with very little depth at the dead low stage. The State of South Carolina has, however, at present under construction and well advanced toward completion a first-class canal and lock, stone masonry, around this portion of the river, which will afford slackwater navigation for boats from the said foot of Gervais street to navigation on the Broad River (the Broad River is simply a continuation of the Congaree). This canal is intended principally to develop the water-power, which is very great at this point, but will also be used for freight boats coming down the Broad River. Every season quite a number of bales of cotton are brought down the Broad River in pole-boats and landed at Columbia. About 1.5 miles below the Gervais Street Bridge the river is crossed by the Charlotte, Columbia and Augusta Railroad iron bridge, built on stone abutments and piers, with its main spans over the river 158 feet in length. Total length of bridge, about 1,083 feet from abutment to abutment. The trains run on the deck of this bridge with the top of the rail 61.0 feet above the dead low-water level. Between the two bridges referred to the fall of the river is very materially reduced, though there are quite a number of rocks, ledges, and bowlders choking up the river. The depth of water, however, is much better than above the Gervais Street Bridge. At the Charlotte, Columbia and Augusta Railroad Bridge, above mentioned, the width of the river is about 480 feet. Half a mile below this bridge is "Old Granby" Landing, which was in former times used as the landing for steamboats running on the river. This point is from 2 to 3 miles from Columbia.

Between "Old Granby" and the railroad bridge there are very few rocks, a gently flowing river, and a depth of water of not less than 4 feet at dead low stage. The width of the river at "Old Granby" is about 500 feet. No rocks are found below this landing, and the river presents a good appearance even now for navigation. About 5 miles above its mouth the river is crossed by a wooden through bridge, Howe truss, 150 feet spans, stone abutments, wooden piers; the total length is 336 feet; height of top of rail above dead low water is 33 feet; width of river at bridge is 317 feet. Upon the whole, the river is wide and deep for an up-country stream, though, of course, after years of neglect it has become obstructed by fallen timber and overhanging trees. Probably in the improvement of it a depth of 4 feet can be made at dead low water from its mouth to Columbia. The people express themselves as being extremely anxious for this river to be opened for navigation, which will give them water transportation for their freights direct between Columbia and northern cities via Congaree and Santee rivers, Mosquito Creek Canal, and Winyaw Bay Bar. They are of the opinion that 4 feet, even 3 feet, at dead low water, would answer for the safe navigation of the river. The Congaree flows through a thickly-settled, fertile farming country, producing a great deal of cotton, corn, &c.; and very large areas of the best-timbered lands are found along its banks. Without the use of the river the people, of course, are compelled to haul their products long distances to railroad lines and to market. This is slow and expensive. Up to the year 1845 two side-wheel steamers, the John Adams and Boatwright, drawing 4 feet, were running on the Congaree between Columbia and Charleston, but about that time they were taken off the river, and since then the channel has become so much obstructed by overhanging trees and fallen timber that no boats have been able to run. At present there is no commerce carried on over the river, for reasons stated above, but there would be a large trade could it be opened for navigation from Columbia. That city has a very large and yearly increasing commerce, and is situated in the heart of the cotton-belt of South Carolina.

About 50,000 bales of cotton are shipped yearly from Columbia.

Twenty-five thousand barrels naval stores and about 450,000 or 500,000 tons of general merchandise are brought there annually. If the river was open for boats to the city, I am informed by the business men that at least 20,000 bales of cotton and 25,000 barrels of naval stores would go thence via river, and probably 130,000 tons of up-freights, general merchandise. In addition there would probably be 5,000 bales of cotton shipped from landings below Columbia, 10,000 barrels of naval stores, and 30,000 tons of up-freights. The timber, lumber, and shingle trade would also be very large. I am indebted to Col. S. A. Pearce, president of the Columbia (S. C.) Board of Trade, and other gentlemen in Columbia, for assistance in gathering the above figures on freight.

I inclose a letter written by Colonel Pearce which explains itself. It is, therefore, thought that the Congaree River is, in every respect, "worthy of improvement." An estimate of the probable cost of completing a detailed survey of the same, from the toll-bridge at foot of Gervais street to the mouth of the river, in order that projects may be formed therefrom to carry on said improvement, is respectfully submitted, as follows:

One first assistant engineer, 42 days, at $5 per day	$210 00
One second assistant engineer, 42 days, at $4 per day	168 00

Three rodmen, 42 days, at $2.50 each, per days	$315 00
Ten laborers, 42 days, at $1 per day	420 00
Four canvas-fitted tents, at $30 each	120 00
Three row-boats, at $20 each	60 00
One baggage-scow, at $40	40 00
One box-stove, at $5	5 00
Cooking utensils	20 00
Two hatchets, at $1 each	2 00
Three hatchets, at $1 each	3 00
Total	1,363 00
Add 5 per cent. for contingencies	68 15
Total	1,431 15

Very respectfully, your obedient servant,

REID WHITFORD,
Assistant Engineer.

Capt. W. H. BIXBY,
Corps of Engineers, U. S. A.

LETTER OF THE PRESIDENT OF THE BOARD OF TRADE OF COLUMBIA, SOUTH CAROLINA.

THE COLUMBIA BOARD OF TRADE,
Columbia, S. C., October 20, 1884.

DEAR SIR: In compliance with your request I give you a few reasons for improving the navigation of the Congaree River as far up as the foot of Senate street in this city. I must necessarily take a general view of the situation as the shortness of your visit will not allow me time to collect the figures of tonnage of merchandise brought to Columbia; but my annual report to the Columbia Board of Trade, a copy of which I will hand you, shows that the tonnage was largely increased last year, which was, as is well known, a bad year for cotton.

Columbia has watched with great interest the work of improvement carried on by the United States Government below on the Santee River and its outlets, and gathers fresh hopes from your visit that she will be placed in water communication with the world. This is the capital of the State, a city containing at least 14,000 inhabitants, and from its location is destined to be the great distributive center of the State. The great water-power now being developed by the State will excel that at Lowell, and when utilized, as it is destined to be in a short period, will make this the great manufacturing center of the South.

The great drawback to many industries in this State is lack of cheap transportation. There are immense growths of the most valuable timber in the upper part of the State which could be rafted down Broad River and find its way to a profitable market, if it can have a water transportation from Columbia. There are quarries of granite within close proximity to the Congaree River, near this city, that could furnish millions of tons of rock for jetty work on the South Atlantic coast and the cities bordering on the coast. The great cypress swamp below Columbia, which has an almost inexhaustible supply of this valuable timber growing upon it, would turn out from its stagnant pools that which makes to the wealth of the country. All efforts to utilize this wood in the manufacture of shingles and wooden ware have failed for want of cheap transportation and a convenient outlet. To the cypress must be added a great growth of hard pine timber, which will be made profitable to cut and saw for the markets of the world. The shipments of cotton by the river must necessarily be very large, both for export and for the North by steamers. The difference in time would not be appreciable, as the cotton could be compressed here and transshipped from boat to steamer without delay and cost of wharfage; whereas now there are often blocks in the shipment of cotton at points where the railroads land cotton for transshipment by sea. These delays occur in the busy season, of course, when there are not enough vessels to take it away from these great railroad depots. The opening of this new route would help to relieve this pressure as well as reduce the cost of transportation. Quite a large amount of cotton comes to Columbia in pole-boats from a long distance up the country, and it is safe to say that the planter would soon avail himself of this method of furnishing him a cheap freight from the mountains to the seaboard. It would also stimulate him to increase his productions of cotton, wheat, corn, oats, &c. Cheap freights would bring settlers to locate along the river, where the lands, I am informed, are rich and productive.

I have thus far spoken of shipments down the river only, but it will require no argument to convince the investigator that the opening of this means of transit for heavy

freights, especially those that do not require rapid movement, will be availed of for the shipment of immense quantities of fertilizers that are annually purchased in the upper portion of the State, and for coal and iron for our foundries, and also for heavy groceries and provisions. I mention Senate street for the present terminus of boating, instead of the old point 2½ miles below the city, as what little obstruction will be encountered from Granby up to Senate street can probably be reduced without great cost. This would bring the boats up abreast of the city. To stop at Granby would subject shippers to a haul of 3 miles over a bad road. The landing at Senate street would be but four squares from the Union Railroad depot.

You are aware of some of the disadvantages under which I have prepared this hasty statement. I can assure you of the earnest support of our board of trade in furthering this important work, which will be of national importance, benefiting the country at large.

Yours, very respectfully,

S. A. PEARCE,
President Columbia Board of Trade.

Mr. REID WHITFORD,
Assistant United States Engineer.

SURVEY OF CONGAREE RIVER, SOUTH CAROLINA.

UNITED STATES ENGINEER OFFICE,
Wilmington, N. C., January 29, 1885.

SIR: I have the honor to submit herewith my report upon a survey of the Congaree River, in accordance with instructions from your office dated 31st July, 4th September, and 21st November 1884.

This report is accompanied by the following maps*:

(1) A general map, drawn to a scale of 1 inch to 8 miles, showing the general surroundings of the river. (From the United States post-route map of South Carolina.)

(2) The Congaree River, from Columbia 49 miles to the Santee, drawn to a scale of $\frac{1}{600}$, and showing all the obstructions to be removed, the depths of water at the time of the survey, and the proper corrections (due to stage of water) which must be deducted from these depths to give the probable low-water depths. (By Drs. McBee and Miller.)

My report of the 24th October, 1884, on a preliminary examination of this locality, gives fully its general physiographical and commercial statistics.

* * * * * * *

I intrusted the survey to Mr. R. J. Latta, civil engineer, of Yorkville, S. C. Mr. Latta, who was, however, taken sick quite unexpectedly, * * * and who had in consequence to give up further charge, deserves much credit for the efficient way in which he organized the survey.

The survey was finally started under Dr. S. McBee, of Lincolnton, as assistant engineer, and Dr. D. B. Miller, jr., city engineer of Columbia, as surveyor and draftsman; and they both deserve great credit for the rapid and efficient manner in which the survey was carried out, in spite of much rainy weather and several river freshets.

* * * * * * *

The report of Dr. McBee, condensed but full, shows that the mere removal of snags, sunken logs, and overhanging trees is about all that is needed to give a clear unobstructed 4-foot navigation from the mouth of the Congaree River upward 47 miles to the old steamer landing at Granby, within 2 miles of Columbia. Judging from my actual present

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*Omitted.

experience with similar work on the Wateree River close by, where sunken logs are often 2 feet in diameter and 80 feet in length, it will require fully $30,000 to clear the Congaree River properly from its mouth up to Granby Landing. I believe that a due consideration of the navigable needs and commercial statistics of this river, as shown in my report of its preliminary examination, will show that it is worthy of national assistance.

Above Granby the river is a veritable rapid, rising about 4 feet per mile, opening out to three times its former width, diminishing proportionally in depth, showing the tops of rocks everywhere at all ordinary stages of water, and having a current of about 6 miles an hour. According to Dr. McBee's estimate it will cost about $24,000 merely to clear out a 100-foot channel through these rocks, and I think it very doubtful if the river steamers could even then navigate the channel with safety. I am inclined to believe that the construction of a canal is the only satisfactory method for getting a navigable channel through from Granby to Columbia. Such a channel would be very expensive. On this account I believe that the two miles of river from Granby to Columbia are to-day not worthy of improvement by the General Government.

I have therefore to recommend at least $30,000 as an amount that can profitably be spent upon the Congaree River from its mouth 47 miles upward, to Granby Landing, in removing snags, rocks, sunken logs, sunken trees, and slight shoals from the bed of the river, in clearing away overhanging trees from its banks, and in properly protecting its caving banks.

Very respectfully, your obedient servant,

W. H. BIXBY,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

REPORT OF MR. S. M'BEE, ASSISTANT ENGINEER.

COLUMBIA, S. C., *January* 22, 1885.

SIR: I have the honor to submit the following report of the preliminary survey of Congaree River from Columbia to the Santee River.

This survey was made in accordance with your instructions of December 8, 1884, to determine the cost of improving the river enough to allow of 4-foot navigation with 100 feet width of channel.

By river it is 49 miles in a southeasterly direction from Columbia to the Santee. The first 2 miles, beginning at Columbia Bridge and ending at Granby, is 1,250 feet wide at the upper end and gradually narrows to 550 at the lower end. It has a fall of about 4 feet per mile, and a velocity of about 4½ feet per second. The channel is obstructed in many places by bowlders and shoals of granite rock, estimated at 7,000 cubic yards. There are no other obstacles to navigation in this part of the river, except that it is crossed by the Charlotte, Columbia and Augusta Railroad Bridge, an iron structure 48 feet above low water.

From Granby to the Santee River there is an average width of about 350 feet, and a velocity of about 2 feet per second. This part of the river was formerly navigable, and would be so now if the snags, sunken logs, and overhanging trees were removed. There are a few places where the soundings show a lack of depth, but in my opinion the sand is retained by snags and logs. The South Carolina Railroad crosses the river 4 miles from its mouth on a Howe truss-bridge, about 25 feet above low water.

There were actually seen and counted in this part of the river 658 snags, 950 sunken logs and trees, and 680 overhanging trees. There were also about 100 cubic yards of rock excavation (5 miles from the mouth of river) and 30,000 linear yards of caving banks (of which perhaps 1,000 linear yards need protection); also two shoals, each apparently about 150 feet long (one at Mill Creek, 27 miles from the mouth of river, the other 4 miles at Old River).

The removal of obstructions actually seen would cost approximately as follows:

From Columbia to Granby:		
7,000 cubic yards of rock, at $3.50		$24,500
From Granby to Santee River:		
658 snags, at $3	$1,974	
940 sunken logs and trees, at $5	4,700	
680 overhanging trees, at 50 cents	340	
1,000 linear yards of caving banks, at $1	1,000	
300 linear feet shoals, at $2	600	
100 cubic yards rock excavation, at $3.50	350	
		8,964
Total		33,464

On account of high water at the time of the survey, many snags and logs must have escaped observation. Moreover, experience in clearing up similar rivers shows that the obstructions which have finally to be removed are generally from two to six times those actually in sight at the first examination or survey.

I therefore think that the following would be a fair estimate of the probable work upon thoroughly clearing up this river:

From Columbia to Granby:		
7,000 cubic yards of rock excavation, at $3.50		$24,500
From Granby to the Santee River:		
2,000 snags, at $3	$6,000	
4,000 sunken logs and trees, at $5	20,000	
5,000 overhanging trees, at 50 cents	2,500	
1,000 linear yards caving banks, at $1	1,000	
2,000 linear feet shoals, at $2	4,000	
150 cubic yards rock excavation, at $3.50	525	
		34,025
Total		58,525

Very respectfully, your obedient servant,

S. McBee.

Capt. W. H. Bixby,
Corps of Engineers, U. S. A.

M 17.

PRELIMINARY EXAMINATION OF BLACK RIVER, NORTH CAROLINA.

United States Engineer Office,
Wilmington, N. C., October 24, 1884.

Sir: I have the honor to submit the following report upon Black River, North Carolina, in accordance with instructions contained in letters from your office dated July 31 and September 4, 1884. As this river was carefully examined in 1883 by Mr. George H. Elliott, assistant engineer (see Report, A 28, of Capt. James Mercur, pages 42, 43, Ex. Doc. No. 30, Senate, Forty-eighth Congress, first session), my own examination was limited to a personal inspection of the river, as a check upon the previous report, and to the collection of general information and statistics from persons who have known the river well for several years.

* * * * * * *

The usefully navigable portion of Black River extends 36 miles from its mouth, on the Northwest Cape Fear, up to Point Caswell, a settlement of about 100 people, the southern terminus of the Wilmington, Point Caswell, Clinton and Raleigh Railroad, now building. From its mouth upward for about 26 miles the river at low and medium water is from 300 to 250 feet wide, and is from 8 to 30 (average 12) feet deep at high tide. It has a rise and fall of tide of about 2 feet, and an alternate ebb and flood of about 2 miles per hour. During freshets the river

rises perhaps 3 feet or more, and extends over both banks to a total width of from 2 to 3 miles.

From 26 to 31 miles above its mouth the river diminishes to 200 feet width, and is from 4 to 20 (average 10) feet deep at high tide. It has a slightly-diminished rise and flow of tide. During freshets it spreads over both banks to from 1.5 to 2 miles total width.

From 31 miles above its mouth, up 5 miles further to Point Caswell, the river is still about 200 feet wide, and is from 4 to 20 (average 8) feet deep at high tide. It still has a rise and fall of tide of nearly 2 feet, with an alternate ebb of about 2 miles and flood of about 1 mile per hour. During freshets the river extends over one bank to a width of from .25 to .50 of a mile.

The steamer John Dawson, of 45 tons, able to carry 300 barrels of naval stores, 100 feet long, 20 feet wide, and of 30 inches draught, runs all the year round from Wilmington to Point Caswell, making 2 round trips per week, without ever being stopped by low water.

The principal obstructions encountered in the 10 miles of river below Point Caswell are the following:

About 26 miles above Wilmington: Old River, 1 log and a 60-foot shoal.

About 25.5 miles above Wilmington: Boro, opposite Moor's Creek, 1 log.

About 31.5 miles above Wilmington: Jackson Pridgeon's Suck, a sharp bend, 3 stumps, and a 30-foot shoal.

About 31.75 miles above Wilmington: Jackson's Suck, a very sharp bend, needing probably a cut-off of 100 feet width and 50 feet length through logs, stumps, and trees.

About 32 miles above Wilmington: Still Bluff, 1 log, and a 50-foot shoal.

About 32.5 miles above Wilmington: Calley Reach, a 300-foot shoal.

About 33.5 miles above Wilmington: a 25-foot shoal.

About 34 miles above Wilmington: Thoroughfare, a 50 foot shoal, caused by a cut-off, which can be easily either opened or closed.

About 34.5 miles above Wilmington: Malpass Reach, 25 logs, and a 75-foot shoal.

About 35.5 miles above Wilmington: Wilson's Cove Reach, a 100-foot shoal.

About 35.75 miles above Wilmington: just below Point Caswell, three 100-foot shoals (caused probably by logs), surrounded by deep water.

About 36.02 miles above Wilmington: Point Caswell Landing.

In short, the only obstructions to free navigation to Point Caswell are 1,040 feet of shoals, probably less than 100 stumps, and a few overhanging trees, distributed at about seven different places. On none of the shoals is the water less than 2.5 feet deep.

At 46 to 48 miles above its mouth, 8 to 10 miles above Point Caswell, from Goff's Narrows to Hawes' Bluffs, the river for about 2 miles is from 65 to 150 feet wide, crooked, and shallow; in many places the depth is not over 12 inches, while the current is about 4 miles per hour. At the bottom of this 2-mile stretch the rise and fall of tide is perhaps 3 inches.

About 56 miles from its mouth, 20 miles above Point Caswell, the river divides into North and South rivers.

The South River is said to be slightly deeper than the North, but full of logs and obstructions.

The North branch is tolerably clear of obstructions up to Lisbon, about 34 miles above the mouth of South River, and once during a freshet has been ascended by a boat of 4 feet draught. The steamer Lisbon, a 30-ton boat, able to carry 200 barrels of naval stores, and of

12 inches draught, still runs one round trip per week to within 10 miles of Lisbon during the high-water season, but it is obliged to stop running during a low-water season of from 4 to 6 months each year.

At present about 10,000 barrels of naval stores and a little timber come down the North branch; 5,000 barrels of naval stores come down the South River; 15,000 barrels more naval stores are collected from the Black River between South River and Point Caswell, making a total of perhaps 30,000 barrels of naval stores and 100,000 feet of lumber collected from above Point Caswell. About 70,000 more barrels of naval stores and perhaps 500 bales of cotton are hauled directly to Point Caswell from the country immediately in its vicinity, making about 100,000 barrels naval stores, 500 bales of cotton, and 100,000 feet of lumber as the total shipment at Point Caswell.

Two new railroads, completely surveyed and partially finished, are expected to reach Point Caswell in one or two years.

The Cape Fear and Yadkin Valley Railroad is completed from Greensborough through Sanford to Fayetteville; it is surveyed through Point Caswell to Wilmington, and the completion of this latter portion depends upon funds expected to be voted and raised next spring.

The Wilmington, Clinton, and Point Caswell Railroad is planned from Raleigh to Clinton, and laid out from Clinton 40 miles to Point Caswell. At the Point Caswell end 30 miles has already been graded, and 15 miles will be in actual operation early next spring. After leaving Clinton this railroad runs nearly parallel to the Upper Black River and crosses it twice, once near Lisbon and once 10 miles above the mouth of South River. This railroad expects to carry next year to Point Caswell for shipment to Wilmington, by water, about—

Cotton	bales..	10,000
Tar	barrels..	10,000
Rosin	do....	100,000
Spirits of turpentine	do....	15,000
Crude turpentine	do...	10,000
Lumber	feet..	3,000,000

The railroad and steamers expect to transport this material at about one-half what has been paid for its hauling and freight by the heretofore roundabout routes to Wilmington, thus saving from $25,000 to $50,000 to the region through which the railroad passes.

At present steamboats of 6 feet draught can easily and safely run 26 miles up the Black River, to within 10 miles of Point Caswell. A small expenditure will probably extend this 6-feet navigation up to Point Caswell, but no reasonable expenditure will give more depth. From Point Caswell up 8 miles to Goff's Narrows there is no shipping point of sufficient importance to demand improvement. Above Goff's Narrows no reasonable expenditure would assure navigation for even as little as 1-foot draught.

For these reasons, considering especially the immediate prospective demands of commerce, the Black River, for about 10 miles down from Point Caswell, is, in my judgment, worthy of improvement to the extent of from $1,000 to $3,000.

A survey sufficiently accurate to determine the exact cost of such improvement and to serve as basis for a project for such improvement could probably be made for $600, including the project and estimate of cost of improvements proper to be made.

Very respectfully, your obedient servant,

WM. H. BIXBY,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

SURVEY OF BLACK RIVER, NORTH CAROLINA.

UNITED STATES ENGINEER OFFICE,
Wilmington, N. C., February 13, 1885.

SIR: I have the honor to submit herewith my report upon a survey of the Black River, in accordance with instructions from your office dated July 31, September 4, and November 21, 1884.

This report is accompanied by the following maps:

(1) General map of Black River and surroundings (from United States post-route map of North Carolina, 1884), scale $\frac{1}{500000}$.

(2) Map of Black River at Old River (26 miles from Wilmington), and also from Pridgeon's Suck (31.5 miles from Wilmington) to Point Caswell (36 miles from Wilmington), scale of $\frac{1}{1200}$; January, 1885.

(3) Map of Black River from Point Caswell (36 miles from Wilmington) to its head near Lisbon (86 miles from Wilmington) scale, $\frac{1}{12000}$; February, 1885.

At the time of my preliminary examination of the river (see report submitted October 24, 1884) the portion of the river above Point Caswell had so little water in it that it was deemed impracticable to attempt its ascent, even in a small boat. Since then the water has risen. I thought best to extend the survey of the river from Point Caswell, as far as a boat could conveniently be sent.

The preliminary survey of the river below Point Caswell was intrusted to Assistant Engineer Charles Humphreys, whose full, though condensed, reports and maps are appended.

The preliminary survey of the upper river was made jointly by myself and Assistant Engineer Charles Humphreys. Our maps and my description of this part of the river are appended. I had received from different sources so many conflicting statements as to the river and its resources and its navigation, that I deemed a personal inspection almost a necessity, although delaying considerably my report upon the whole river.

As a result of this personal inspection, I find that the previous reports of Capt. James Mercur and Mr. George H. Elliott (see pages 42, 43, Senate Ex. Doc. No. 30, Forty-eighth Congress, quoted in full in my report of preliminary examination), and my own report of October 24, 1884, are very accurate, with the exception of underestimates of the actual present and probable future commerce of the river. I find that about $700,000 of all kinds of goods are annually sent down to Wilmington from the valley of the Black River and its tributaries, with an annual expense of about $50,000 for this transportation. These freights might be easily reduced 20 per cent. by increased facilities for navigation, and the shipments would increase rapidly as the freights diminished. About 20 per cent. of these shipments pass over the Black River between its head and the entrance of the South River, about 30 per cent. comes in by the South River, about 30 per cent. is received between the South River and Point Caswell, and about 20 per cent. comes directly from around Point Caswell.

The projected railroads to terminate at Point Caswell show no signs that they will be actually operated during the next few years.

The river below Point Caswell, already navigable all the year round for boats of 2.5 feet draught, is already about equal to its commerce, but it needs the removal of a few logs, snags, and overhanging trees, and the rounding off of one or two extra sharp points. This improved 2.5-foot channel will cost about $2,500, 4-foot channel about $6,500, and a 6-foot channel about $23,000.

The river above Point Caswell runs nearly dry every summer, but can be made reasonably navigable for rafts and for boats of 2.5 feet draught during six to ten months each year by the removal of logs, snags, and overhanging trees, and by the rounding off of a few extra sharp points. This cleared 2.5-foot channel will cost about $12,000, and if further put in thorough order by dredging through the shoals, and by dredging or diking the so-called "Narrows," it will cost at least $15,000 more. The navigation of this portion of the river is now controlled by private parties (see appended extract from the laws of North Carolina), who claim that the river is their own property, and is already navigable. I see no reason why the United States Government should improve this property until these claims have been bought out by the State or neighborhood and ceded to the United States.

The lower third of the upper river—*i. e.*, the portion between Point Caswell and the entrance to South River—is the portion of the river which is to-day in most need of assistance. The future development of the whole of Sampson County depends almost entirely upon the transportation facilities down the Black River and its tributaries. Under these circumstances, I think that the Black River, North Carolina, is worthy of moderate improvement by the General Government.

I have, therefore, to recommend at least $10,000 as an amount that can profitably be spent in improving the Black River, North Carolina, from Wilmington to Lisbon, by removing logs, snags, and overhanging trees from the bed and banks of the river, and by rounding off a few of its extra-sharp bends, the greater part of this amount to be spent on the river between Point Caswell and the mouth of South River, provided that all claims of private parties to the navigation of the river shall be ceded to the United States Government, free of charge, before the commencement of such improvements.

Very respectfully, your obedient servant,

W. H. BIXBY,
Captain of Engineers.

The CHIEF OF ENGINEERS,
U. S. Army.

[First indorsement.]

UNITED STATES ENGINEER OFFICE,
Baltimore, Md., February 19, 1885.

Approved and respectfully forwarded to the Chief of Engineers, attention being specially invited to the proviso which limits his recommendation for improvement of this river by the United States.

WM. P. CRAIGHILL,
Lieut. Col. of Engineers.

DESCRIPTION, BY CAPTAIN W. H. BIXBY, OF THE BLACK RIVER ABOVE POINT CASWELL, NORTH CAROLINA (WITH MAP).

WILMINGTON, N. C., *February* 13, 1885.

This portion of the river was examined by myself and Mr. Humphreys in a small steamer of about 23 feet width and 14 inches draught. The river was mapped as we went along, directions being read from the compass, distances being estimated by eye, and checked by time measurements, and by the estimated speed of the steamer, and the results being immediately plotted on cross-section paper to a scale of 1 inch to 1,000 feet, before leaving each portion of the river thus mapped. (This method of survey was afterwards continued over 2 miles of known river and showed an average error of less than 2 per cent.)

From Point Caswell (36 miles from Wilmington) to its head (84 miles above Wilmington), a distance of 48 miles, the river has a variable width of from 65 to 150 feet, an average depth of from 2 to 3 feet at ordinary low water, and a variable current of from 2 to 5 miles an hour. The bends vary in number from 2 to 12 per mile, and short shoals are found at an average of one every 2 miles. Projecting and overhanging trees, especially at the bends, seriously impair the navigation at high water, and numerous snags and sunken logs increase the difficulty of navigation at low water.

During the summer the water remains nearly constant at its low-water stage. At a variable date between August and December the river generally rises 5 to 8 feet in one week, thus reaching suddenly its winter high-water stage, and remains up till about April. After April, and before July, it falls gradually to its summer low-water stage.

In three places the river passes through a cypress swamp, the river channel in each case being very crooked, very narrow, and very shallow, a large amount of water flowing away from the channel directly into the swamp. All these narrows are between the mouth of South River and Point Caswell. These narrows can be much improved by the removal of logs and snags from the channel; but they cannot be put in thorough navigable order except by dredging, cutting, or diking. The position and lengths of these narrows are as follows:

Name.	Distance above Wilmington.	Length.
	Miles.	*Miles.*
Goff's Narrows	40–42	2
Haws's Narrows	43–45	2
Beatty's (or South River) Narrows	51–53	2

The thorough improvement of these narrows may require 8,000 linear feet of cut-offs at $12,000, or 20,000 linear feet of diking at $30,000.

The shoals in this portion of the river are usually short, and carry only about 1 foot depth of water during the summer months. Their positions and lengths are as follows:

Location.	Distance above Wilmington.	Length.
	Miles.	*Feet.*
Near Buzzard Landing	36.5	200
Below Sparkelbury Landing	39.5	2,500
Haws's Bluff	43.0	600
Above Beatty's Bridge	50.5	1,000
Tony Bluff	52.0	600
Above Corbett's Landing	57.5	1,000
Do	57.8	
Herring's Landing	63.4	100
Above New Kirk Bridge	65.5	100
Below Cantey's Cove	69.3	100
Vaughn Mill Creek	71.2	100
Mossy Log Landing	71.6	500
Below Fenel Cove	72.5	200
Above Fenel Cove	73.0	200
Big Bend	73.7	100
Below Sykes's Landing	74.75	200
Herring Landing	76.0	100
Below Clear Run	77.75	200

The logs and overhanging trees all along the river are so numerous that their proper removal will cost about $150 per mile for the removal of the logs and snags, and $50 per mile for the proper trimming, cutting, and hauling back of the overhanging trees. This work is especially needed at the bends, where the river should be cleared to its full width to allow of the necessary swing of the boats in passing around the points.

At a few points, such as Old Cotton Patch turn (79.7 miles above Wilmington), the river makes an acute-angled turn, which might easily be rounded off by removing the cypress trees and roots at the bend or by making a short cut-off about 200 feet total length. These acute-angled turns throw the descending craft into the trees and stumps of the concave shore and seriously damage boats, and even seriously impede the passage of rafts.

There are eight bridges upon the river from Point Caswell to Lisbon, inclusive, as follows:

Bridges.	Distance above Wilmington.	Clear width of span.	Clear height above m. l. w.
	Miles.	*Feet.*	*Feet.*
Point Caswell	36.0	.....	.....
Point Caswell, draw-span	.....	21	11.5
Point Caswell, raft-span	.....	28	11.5
Beatty's raft-span	49.8	35	15
Corbett's raft-span	57.5	28	15
Kerr's*	60.2	.....	.....
New Kirk	65.3	30	20
Clear Run, raft-span	77.8	26	15
Carter's raft-span	84.7	30	14
Treedwell, raft-span	86.6	28	14

* Half torn down.

One of these bridges—that at Point Caswell—is provided with a draw-span, but this draw-span is so narrow, so low, and so difficult to move, that it is a more serious obstruction to navigation than any of the other bridges. If the river is to be much used by steamers, all the bridges (that at Point Caswell included) should be provided with draws of at least 25 feet clear width, and arranged so as to be moved by one man.

The commerce of the Black River and its tributaries is principally in naval stores, timber, cotton, and eatables. At present the most of this is rafted down the river, although a small portion comes down by flats and by steamer. These rafts generally contain each from 15,000 to 20,000 feet of timber, or from 200 to 250 barrels of rosin. During the five days of the survey, we actually passed about 620,000 feet of timber and about 10,000 barrels of rosin, either in such rafts or on flats, or standing at the river's edge waiting for transportation. Fully half of these rafts come from South River, but many come from the Six Runs and the Coharie rivers, above the head of the Black River. It is said that 140 of these rafts have been seen to pass Point Caswell in a single day, when a high freshet has succeeded a long drought.

We were told of the existence of at least 10 turpentine stills on the South River, and of at least 12 more such s ills on the Black River and its upper tributaries. Each of these stills is said to turn out in a good season 125 barrels of spirits of turpentine and 400 barrels of rosin per month, for several months.

The spirits of turpentine and the cotton are too valuable to be *rafted* down the river, and so have heretofore had to be hauled from 20 to 40 miles to the Cape Fear River, or to the nearest railroad.

Mr. John D. Kerr, a prominent citizen of the Black River Valley, estimates the commerce of the Black River at $750,000 annually. His estimate is appended. As before stated, we actually passed 620,000 feet of timber and 10,000 barrels of rosin during our five days' survey. As the freshet had been equally high for a few weeks, and as the rafting season was hardly begun, it is fair to assume that we did not actually see more than one-sixteenth of all the timber nor more than one-tenth of all the rosin shipped during the entire year. This rough calculation would indicate—

Timber	feet..	10,000
Rosin	barrels..	100,000
Spirits of turpentine	do....	25,000
Worth in all		$500,000

I do not think $200,000 more a high estimate for the cotton, tar, and eatables of Sampson County.

The stern-wheel steamer Lisbon, a 30-ton boat, 30 inches draught when loaded, is now making two round trips per week between Wilmington and Clear Run.

Respectfully submitted.

W. H. BIXBY,
Captain of Engineers.

REPORT OF MR. CHARLES HUMPHREYS, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Wilmington, N. C., January 31, 1885.

CAPTAIN: I have the honor to forward herewith map of Black River, ordered in your letter of January 3, 1885.

We sounded the Black River from Point Caswell to its mouth, but having seven days of very bad weather for field work, on three of which it rained, we made a

careful survey only from Point Caswell to a point 4.25 miles below, whence 5.3 feet may be carried to Wilmington at mean low water, summer stage. There being a small freshet at time of survey, mean low water was determined by marks of steamboat men and residents along the river.

A channel 75 feet wide and 6 feet deep at mean low water would require dredging as follows:

	Cubic yards.
Old River, 24 miles to Wilmington, cut-off through point	1,100
Pridgeon Suck, across point	8,333
0.33 mile above Cunning Bluff (can carry 5.3 feet)	1,400
At Long Bluff (can carry 5.3 feet)	1,600
4.12 miles below Point Caswell, see map (can carry 5 feet)	350
3.25 miles below Point Caswell (can carry 3.2 feet)	12,260
2.75 miles below Point Caswell (can carry 4 feet)	2,777
2.5 miles below Point Caswell, widen	2,222
2.2 miles below Point Caswell, widen	450
Around Mason Thoroughfare	16,869
(Or through Mason Thoroughfare, 16,000 cubic yards.)	
Upper mouth Mason Thoroughfare to 1.5 miles below Point Caswell	2,778
1.5 mile to 1.25 mile below Point Caswell	7,000
1.25 mile to 1 mile	1,944
1 mile to 0.75 mile	5,555
0.75 mile to 0.5 mile	3,944
0.5 mile to 0.25 mile	6,310
0.25 mile to Point Caswell	3,514
Total	78,406

A channel 4 feet deep and 75 feet wide would require dredging as follows:

	Cubic yards.
Point Caswell to 0.25 mile below	1,250
0.25 mile to 0.5 mile	2,000
0.5 mile to 0.75 mile	.....
0.75 miles to 1 mile	560
1 mile to 1.25 mile	.....
1.25 mile to 1.5 mile	500
1.5 mile to upper mouth Mason Thoroughfare	733
River around Thoroughfare	5,580
(Or through Mason Thoroughfare, 9,000 cubic yards to 2.5 miles.)	
2.5 miles to 2.75 miles	370
2.75 miles to 3 miles	.....
3 miles to 3.25 miles	463
3.25 miles to 3.5 miles	333
Across Pridgeon Suck	6,000
In addition it would be a help to dredge at Old River (see map)	1,100
Total	18,889

In case it is thought advisable to build jetties, they will probably be needed as follows:

	Linear feet.
At Old River	130
At 3.25 miles below Point Caswell	320
At 3 miles below Point Caswell	190
At 2.75 miles below Point Caswell	130
At 2.375 miles below Point Caswell	250
At 2.125 miles below Point Caswell	100
At Betty's Hole	100
Upper end of Mason Thoroughfare	110
At 0.875 mile below Point Caswell	150
At 0.5 mile below Point Caswell	75
At 0.25 mile below Point Caswell	130
At 0.125 mile below Point Caswell	100
Total	1,785

We counted 878 leaning trees, 53 stumps, 50 snags.

I think the present necessities of navigation can be satisfied by dredging the 4-foot channel, building 600 linear feet jetties, removing 878 leaning trees, 53 stumps, and 50 snags.

I estimate this to cost as follows:

18,889 cubic yards of dredging, at 20 cents	$3,777 80
600 linear feet of jetties, at $2	1,200 00
878 leaning trees, at $1	878 00
53 stumps, at $3	159 00
50 snags, at $2	100 00
Total	6,114 80
Contingencies, &c., 5 per cent	305 74
Total	6,420 54

The tide is said to swell 3 or 4 inches in the summer at a point nearly 20 miles above Point Caswell. In summer the flood tide is sufficiently strong to swing the steamer John Dawson at Point Caswell. During the survey the rise and fall was about 1.5 foot at Point Caswell. The flood tidal current was not noticeable at a point 4 miles below, and the ebb current was about 1 foot to 1.25 foot per second.

Very respectfully, your obedient servant,

CHAS. HUMPHREYS,
Assistant Engineer.

Capt. WM. H. BIXBY,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

BLACK RIVER, N. C., *January*, 1885.

The annual transportation of products down Black River is about as follows:

Turpentine (including spirits and rosin)	$450,000
Tar	50,000
Timber, lumber, &c	150,000
Cotton (increasing yearly)	50,000
Chickens, eggs, beef, pork, &c	20,000
Total	720,000

The last item would be double if transportation were certain.

I think the above a low estimate for any year when naval stores are a fair price. The natural flow for the goods and family supplies for this section is up this river.

Very respectfully,

JNO. D. KERR.

Capt. N. G. SHAW,
Steamer Lisbon.

AN ACT to incorporate the Black River Navigation Company.*

SECTION 1. *The General Assembly of North Carolina do enact:* That C. Howe, Alfred Martin, John C. Myer, Haywood Boykin, E. S. Ward, John Smith, Alrich Adrian, and Henry Vollers, and their associates and successors, shall be, and they are hereby, constituted a body-politic and corporate by the name of "The Black River Navigation Company," and by that name they and their successors shall have succession, and shall be capable of suing and being sued, of answering and being answered, defending and being defended, in all courts and places whatsoever, in all actions, suits, complaints, matters, and causes whatsoever, and they and their successors may have a common seal, and may change and alter the same at their pleasure.

SEC. 2. That the capital stock of said company shall be $5,000, with the privilege of increasing the same to $20,000, divided into shares of $100 each.

SEC. 3. That said company shall have power to build or purchase one or more steamboats, and other necessary tow-boats, flats, and lighters, to be employed in navigating the waters of Big Coharie, Black River, and Cape Fear, between Lisbon, in the county of Sampson, to Wilmington, and to purchase and hold land on the banks of said river on which to erect all wharves and warehouses requisite for landing and storing all articles transported by said company.

SEC. 4. That in order to induce and enable said company to clear out, improve, and render fit for steamboat navigation the waters of Big Coharie and Black rivers, above the point on Black River at which such navigation is now practicable, the said

*Quoted from chapter 37, pages 657 to 659, Laws of North Carolina, for 1876–'77.

company shall have the sole and exclusive right and privilege to navigate said rivers with steamboats from Point Caswell, in the county of Pender, to all points up said Black River and Big Coharie for the period of fifty years: *Provided*, Said company shall not prevent any persons from fishing in said river.

SEC. 5. That unless said company shall complete the improvement mentioned in the last preceding section of this act as far up as Lisbon, to a degree sufficient to render steamboat navigation safe and beneficial to the public, within five years from this date, and unless said company shall continually thereafter keep said rivers so navigable, the company shall forfeit all rights, privileges, and franchises under this act.

SEC. 6. The said company shall have power and authority, from time to time, to make all necessary rules, regulations, and by-laws for the government and direction of the concerns thereof not inconsistent with the constitution and laws of this State and of the United States, providing therein for the appointment of the officers and managers of said company, the disposition, transfer, and mode of representation of its stock, the establishment of rates of freights, and all other matters necessary to carry into effect the objects of this incorporation.

SEC. 7. That this act shall take effect from and after its ratification.

Ratified the 24th day of February, A. D. 1877.

M 18.

PRELIMINARY EXAMINATION OF THE ENTRANCE TO WINYAW BAY, NEAR GEORGETOWN, SOUTH CAROLINA.

UNITED STATES ENGINEER OFFICE,
Wilmington, N. C., October 26, 1884.

SIR: I have the honor to submit the following report upon a preliminary examination of the entrance to Winyaw Bay, near Georgetown, S. C., in accordance with instructions from your office dated July 31 and September 4, 1884:

The bar entrance to Winyaw Bay has already been partially surveyed by Mr. Charles M. Yeates, under the direction of my predecessors, Capt. James Mercur and Capt. C. D. Phillips (see pages 1122 to 1127, Appendix I 26, Annual Report of Chief of Engineers, U. S. A., for 1882), but the survey was not entirely completed, for want of sufficient funds.

The present report is based upon the above report of Captain Mercur and Mr. Yeates, and the report (also appended) of my assistant engineer, Mr. Reid Whitford, to whom the new examination was intrusted, both checked by a personal visit to Winyaw Bay made by myself in September of this year.

Winyaw Bay forms the entrance to Georgetown Harbor, and the two together form a single magnificent harbor, which will serve next year as the outlet to over 900 miles of navigable rivers and 100,000 square miles of adjacent lands, of which about 450 miles of river are really serviceable, and 50,000 square miles of land is beyond available reach of railroad transportation. The estimated commerce of this harbor is placed to-day at about 150,000 tons of outward freight and 200,000 tons of inward freight. Its exports would undoubtedly double or treble in quantity could vessels of 12-foot draught enter and leave its waters at all tides. At present the depth of water at the bar entrance at lowest tides is not over 7 feet; at average low tide, 8.5 feet; at average high water, 12 feet. Within the bay and harbor, vessels of 12-feet draught will by next July be able to go anywhere at the lowest tides.

A railroad now in running order runs from the South Carolina Railroad directly to Georgetown, and adds to the value of Georgetown as a port of entry and export.

In my opinion the entrance to Winyaw Bay, near Georgetown, S. C., is worthy of improvement, and a full survey of the same desirable.

Owing to the very extended area of 25 to 30 square miles of territory to be surveyed, to its shallow water around the bars, and to its very exposed position, a surveying party must be on hand every day for about eight weeks in order to do three weeks' work. An insufficiency of funds for the survey would undoubtedly lead to the same result as in 1881, viz. the failure to obtain as much information as was desirable. On this account I estimate that it would require an available sum of $4,000 in order to assure a survey sufficiently accurate for use as a basis for the project of improvement, including the project and estimates of cost of improvements proper to be made.

Very respectfully, your obedient servant,

WM. H. BIXBY,
Captain of Engineers, U. S. A.

The CHIEF OF ENGINEERS, U. S. A.

REPORT OF MR. REID WHITFORD, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Georgetown, S. C., October 24, 1884.

CAPTAIN: In obedience to instructions contained in your letter of October 4, 1884, I have the honor to report as follows upon the preliminary examination of the bar at the entrance to Winyaw Bay:

This examination has been made with the view to determine the importance or necessity of a survey in detail of the same locality, in order that projects might be formed for improving the outlet to the sea, removing certain sand-bars by the construction of stone riprap jetties or otherwise. Lines of soundings reduced to mean low water were partially taken through the channel around North Island Point, through "Bottle Channel," and also down the channel now in use, and all extending to the 25-foot sea-curve, as shown on the accompanying tracing.

Having finished this examination, it is now respectfully recommended that a survey in detail be ordered at as early a day as practicable, covering that area laying between some point in Winyaw Bay and the 25-foot sea-curve to the south, east, and northeast.

This should embrace a thorough sounding of the North Island Point, the "Bottle Channel," and also the channel now in use, carefully taking the directions and the velocities of the currents therein. Such soundings as might be essential to arrive at the height and extent of the sand-shoals included within this area should also be taken. The following are thought to be reasons why this survey should be executed, looking to the future deepening of the water on the bar:

The passage now being opened via Mosquito Creek between Santee River and Winyaw Bay will connect this bar with about 965 miles of navigable water-courses for light steamers, as follows:

	Miles.
Waccamaw River	200
Great Pedee River	216
Santee River	184
Wateree and Congaree rivers	110
Black River	55
Little Pedee, Sampit, Lynch, and Black rivers, and Mingo Creek	200
Total	965

These rivers all flow through an exceedingly fertile farming country and are bordered by an almost inexhaustible supply of every variety of timber known in the Southern States. The opening of the Congaree will give Columbia, the capital of the State, a flourishing city situated in the center of the cotton belt and at the head of navigation of that river, direct water communication with Winyaw Bay, Georgetown Harbor, &c.; and by opening the Wateree to Camden, a growing and important town, also in the cotton belt, the same communication will be promoted. Much freight will naturally seek an outlet over these highways via Winyaw Bay and the bar.

The Great Pedee and Waccamaw are also rivers of importance, upon which com-

merce is yearly increasing, and a still greater impetus will be given thereto as they are cleared of obstructions and opened to free and safe navigation. With these facilities for cheap water transportation and the many resources of the country, there is no reason why Georgetown Harbor should not become a point of considerable commercial magnitude. A sufficient depth of water on the bar is the key which alone can open the door to this entire and splendid system of river transportation. Safe and uninterrupted navigation will encourage the capitalist to invest his means in sail and steam lines to Northern cities and foreign ports.

No stronger argument can be adduced to prove the present uncertainty of navigation over the bar than the fact that during the writer's short residence at South Island he has known vessels drawing no more than from 11 to 12 feet to be detained for two weeks awaiting a "flush high water" to take them over. And, further, the schooner B. J. Hazard, owned in Georgetown, and drawing 12 feet, was, not long since, detained twenty-three days from the same cause, losing not only the time of an entire trip to New York, but also incurring a loss to her owners of at least $800.

However great distress a vessel may be in while approaching this bar, no tug drawing over 7 or 8 feet can go to her assistance during low water. The regular line steamer between Charleston and this place, though drawing but 6.5 feet water, is frequently, during rough weather, compelled to await high water before attempting to cross.

The commerce of Georgetown Harbor is steadily increasing, and would do so much more surely and rapidly could a better outlet be established. The manager of the Clyde line of steamers, I am informed, has refused to run his boats between this point and Northern cities, on account of the bar; and a syndicate of Boston gentlemen were compelled to relinquish a scheme they had inaugurated for the construction of a railroad from some point West to Georgetown because of the same objection—want of proper and safe navigation for a line of steam vessels to run in connection therewith.

That Georgetown, Conway, Cheraw, Camden, and Columbia, all thriving towns, need water transportation is unquestioned, since they are now left entirely to the mercy of railroad monopolies, without an opportunity of exciting that competition which is the life of trade.

The following commercial statistics for Winyaw Bay Bar have been carefully collected by the undersigned from the most reliable sources for the year ending June 30, 1884:

OUTWARD FREIGHT.

Cotton	bales..	23,100
Clean rice	tierces of 600 pounds..	14,960
Rough rice	bushels..	220,000
Rice flour	do....	20,000
Spirits turpentine	casks..	35,000
Rosin	barrels..	200,000
Tar	do....	3,500
Lumber	feet..	15,000,000
Shingles	number..	3,500,000
Fish	pounds..	50,000
Game	do....	15,000
Wool	do....	40,400
Hides	do....	43,000

INWARD FREIGHT.

Two hundred thousand tons (estimated) general merchandise, such as hay, salt, lime, fertilizers, dry goods, groceries, &c. Of the lumber, 2,383,331 feet, together with 542,200 shingles, were shipped direct to South America and the West Indies. The balance of freight went to home ports.

The commerce is carried on yearly by about 295 sail of sea-going vessels, averaging about 500 tons each, and a number of smaller trading schooners, of which no account could be obtained. There are also about 260 trips of steamers yearly between Georgetown and Charleston, averaging about 300 tons each.

Below is respectfully submitted the probable cost of completing the survey in detail, covering an area of about 30 square miles, more or less:

60 days' hire of steamer, at $25 per day	$1,500
60 days' hire of first assistant engineer, at $5 per day	300
60 days' hire of second assistant engineer, at $4 per day	240
60 days' hire of recorder, at $2.50 per day	150
60 days' hire of current observer, at $2.50 per day	150
60 days' hire of two sounders, at $2 each per day	240

60 days' hire of 12 laborers, at $1.25 each per day	$900
20 sea ranges, at $10	200
25 inside ranges, at $5	125
40 yards of flagging, at 10 cents	4
50 flag-poles, at 20 cents	10
Total	3,819

Very respectfully, your obedient servant,

REID WHITFORD,
Assistant Engineer.

Capt. WM. H. BIXBY,
Corps of Engineers.

SURVEY OF THE ENTRANCE TO WINYAW BAY, NEAR GEORGETOWN, SOUTH CAROLINA.

UNITED STATES ENGINEER OFFICE,
Wilmington, N. C., January 31, 1885.

SIR: I have the honor to submit herewith my report upon a survey of the entrance to Winyaw Bay, near Georgetown, in accordance with instructions from your office, dated July 31, September 4, and November 21, 1884.

This report is accompanied by the following maps:*

(1) Map of Winyaw Bay Bar (1885), to a scale of $\frac{1}{12000}$.
(2) Cross-section of the throat of Winyaw Bay (1885), to a vertical scale of $\frac{1}{120}$ and a longitudinal scale of $\frac{1}{12000}$.
(3) Direction and velocity of observed *ebb* currents in Winyaw Bay (1885).
(4) Direction and velocity of observed *flood* currents in Winyaw Bay (1885).
(5) Map of Winyaw Bay Bar in 1885, to a scale of $\frac{1}{40000}$.
(6) Map of Winyaw Bay Bar in 1877, to a scale of $\frac{1}{40000}$.
(7) Map of Winyaw Bay Bar in 1881, to a scale of $\frac{1}{40000}$.
(8) Map of Winyaw Bay Bar in 1884–'85, to a scale of $\frac{1}{40000}$.
(9) Project No. 1 of Capt. James Mercur in 1881.
(10) Project No. 2 of Capt. James Mercur in 1881.
(11) Project No. 3, Assistant Engineer R. Whitford, in 1884–'85.
(12) Movement of water at mid-ebb, 1885 (W. H. B).
(13) Project No. 4 of Capt. W. H. Bixby, 1885, at $300,000.
(14) Project No. 5 of Capt. W. H. Bixby, 1885, at $480,000.
(15) Project No. 5 of Capt. W. H. Bixby, 1885, at $1,250,000.
(16) Project No. 5 of Capt. W. H. Bixby, 1885, at $1,400,000.
(17) Project No. 5 of Capt. W. H. Bixby, 1885, at $2,500,000.
(18) Project No. 5 of Capt. W. H. Bixby, 1885, at $1,000,000.
(19) Map of Winyaw Bay (supposed to be made in 1802), scale of $\frac{1}{120000}$.
(20) General map of Winyaw Bay and surroundings (from United States post-route map of North Carolina, 1884), scale $\frac{1}{500000}$.

Winyaw Bay forms the entrance to Georgetown Harbor, and the two together form a magnificent harbor. At the completion of the improvements at present in progress at Mosquito Creek and Georgetown Bar, this harbor will then serve as the outlet to over 900 miles of navigable rivers and 100,000 square miles of adjacent lands, fully half the river length being really serviceable, and half the land being beyond the reach of railroad transportation. The estimated commerce of the harbor is placed to-day at 150,000 tons of outward freight and 200,000 tons of inward freight.

Its exports would undoubtedly double or triple in quantity if vessels of 12-foot draught could only cross its bar entrance at all tides.

A railroad now in actual operation connects the South Carolina Central Railroad with Georgetown, and adds to the value of Georgetown as a port of entry and export.

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* Maps omitted.

The bar entrance to Winyaw Bay was partially surveyed and its improvement reported upon under and by my predecessors, Capt. James Mercur and Capt. C. B. Phillips (see pages 1112 to 1127, Appendix I 26, Annual Report of the Chief of Engineers, United States Army, for 1882); but the survey was never completely finished, nor have my predecessors' projects so far been carried out.

The present examinations and survey were intrusted by me to Assistant Engineer Reid Whitford; but I have myself personally visited the work during its progress. As the money allotted to me for the surveys in my charge was much less than my estimates, I was unable to obtain as much information as was desirable, especially as to current measurements. For the reasons mentioned in my preliminary report, only about half to one-third the time could be utilized. The surveying party met almost continuously with stormy weather (rough seas and high waves), with foggy weather, rainy weather, and chilling weather. The amount of work done under these circumstances was more than I had any right to expect, and reflects great credit upon the untiring energy of Mr. Whitford and his assistants.

Mr. Whitford's report is as full and complete as time and money would allow. It includes nearly all the information so far collected with reference to Winyaw Bay, both physiographically and commercially. It is herewith inclosed, with its maps (sheets 1, 2, 3, 4). All opinions, including those of my predecessors and myself, are to the effect that the bar is worthy of improvement; that dredging would be inefficient; and that either high or submerged dikes or jetties would deepen and preserve the channel. The only questions so far left unsettled are which of the present bar channels should be selected for final use, how the jetties should be located, and how much money the United States Government is willing to appropriate for the benefit of Georgetown Harbor and the commerce of Eastern South Carolina.

Winyaw Bay Bar has suffered but comparatively little change during the last thirty years. It forms a natural breakwater, connecting North and South Islands. Small boats can cross the bar through the "slough" close to North Island, and through "Bottle Channel," 2 miles farther south; but vessels of 9 feet draught and upwards can only cross at the extreme point of the bar, 4 miles south of North Island and 2 miles east of South Island. The present main entrance has been the main entrance for probably the last eighty years. It is best protected from the heaviest (northeasterly) storms, and it opens directly upon the best (20 to 28 feet) depth of water. Winyaw Bay is the drainage outlet to about one-third of South Carolina and about one-sixth of North Carolina. It has an inner tidal basin of about 12 square miles within 8 miles of its outlet, and an outer tidal basin of 8 square miles within the outline of its bar. Within these tidal basins it has a rise and fall of tide of about 3.5 feet, and under these circumstances it is not surprising that at middle of its ebb it pours out nearly 220,000 cubic feet of water per minute, with an average velocity of 2.1 feet per second, through a passage-way of 4,000 feet width, scouring this passage to an average depth of 21 feet and a channel depth of 32 feet. Such a moving mass of water, guided merely by training-walls high enough to prevent unnecessary overflow, would not have the slightest difficulty in cutting and maintaining through the bar an exit of 4,000 feet width and 15 feet average depth or 20 feet channel depth. Leaving out of consideration the question of cost, I have no hesitation in saying that the best protected, most permanent, and deepest bar entrance, obtained in the simplest and most satisfactory way, is that obtained by the use of high training-walls, rising to half-way between high and low water mark, crossing all other

channels, and extending from both shores to both sides of the present main bar-entrance. Such training-walls, dikes, or jetties should be built of heavy stone riprap; may be well located in general, as shown in project 8 (sheet 17); and will cost approximately $2,500,000.

As this amount of money may exceed that which the United States Government may decide to appropriate for this work, I have considered other less expensive projects, suggested either by my predecessors, by myself, or by others. In presenting these projects I wish, however, to state very emphatically that nearly every project was proposed by its originator not as the best project, but only as a compromise between that which he thought best and that which would be allowed by the expected insufficient appropriation.

Captain Mercur, in 1881 (see page 1122, Annual Report of the Chief of Engineers for 1882), suggested two projects: one (see Project 1, Sheet 9) of two nearly parallel submerged jetties, of 60,000 feet total length and 8.5 total height, leading to the present main bar entrance, to cost probably $3,000,000, though not stated; the other (see Project 2, Sheet 10) of two similar jetties, of 30,000 feet total length and 8.5 feet total height, leading to the Bottle Channel Bar entrance, to cost about $1,500,000. The latter channel was to have its mouth continuously swept clear by a littoral current, supposed to run southwardly along the outer side of the deep breakers. Everything tends to point to the existence of this littoral current, but even the present survey failed to prove whether it really was there or not.

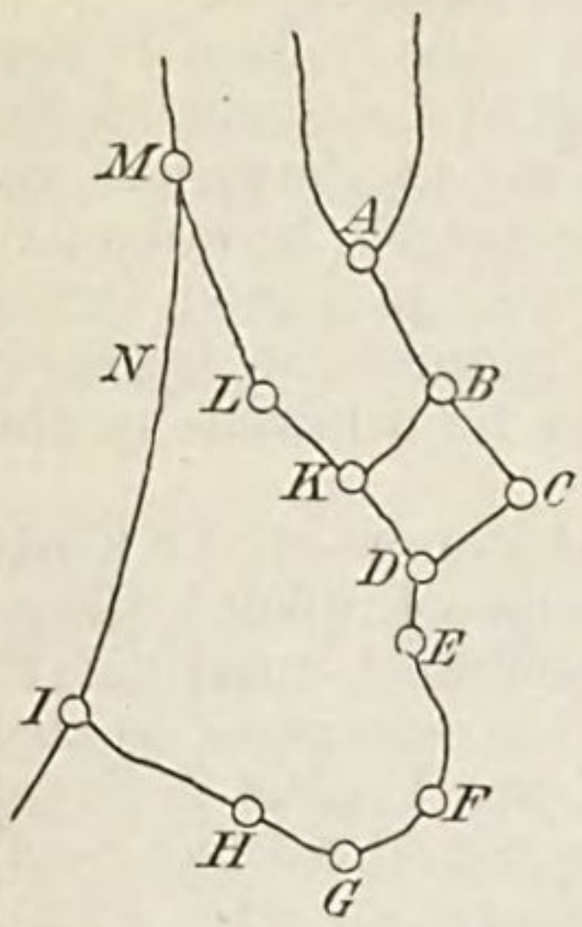
Mr. Whitford, assistant engineer, after conducting carefully the present survey, suggests similar submerged jetties (see Project 3, Sheet 11) through Bottle Channel, except that he extends the shore end of the southern jetty way back to the shore of South Island, a measure that I regard as an eminently necessary precaution against the partial washing away of Mother Norton Shoal under the increased pressure and current which will be caused by the proposed partially-obstructing jetty walls. These jetties have a total length of about 27,000 feet, a height of from 5 to 8 feet, and are expected by him to give from 13 to 15 feet depth of water over a width of 1,800 feet bar entrance, at a total cost of about $950,000. If submerged jetties, leading to Bottle Channel, are to be used, I should recommend Project 2 of Captain Mercur essentially as it is thus modified by Mr. Whitford.

In order to show more fully the movement of the water as it moves across the Winyaw Bay Bar, and to show what beneficial results may be probably expected per dollar of expenditure, I have supposed one case of submerged jetties and several cases of high jetties, and have deduced approximately the corresponding changes in volume and velocity of water as the latter flows out from the inner-bar basin at a period of about mid-ebb, when the tide, having fallen 1.5 feet, is still 2 feet above low water. The results are shown on Sheets 12 to 18, inclusive.

Let A be the southern end of North Island; MI be the shore of South Island; ML be crest of the Mother Norton Shoal; AM be the mouth of Winyaw Bay; AB be the throat of Slue and crest of the Upper Dry Breakers; BK be the throat of Bottle Channel; BC be the mouth of Bottle Channel; LK be the throat of the Main Channel; FG be the mouth of the Main Channel; KD be the division line between Bottle Channel and the Main Channel; CD the crest of the Middle Dry Breakers; DE the crest of the Little Dry Breakers; EF the crest of the North Breakers; GH the crest of the South Breakers, and HI the crest of the South Island Shoals.

Now when the water pours through AM (the mouth of Winyaw Bay),

with 4,000 feet width, 30 feet maximum depth, and 21 feet average depth at mid-ebb, it suddenly finds itself hemmed in by an inner basin, ABKLM, whose crest, 19,000 feet long, is on an average about 8 feet below the surface of the water. At AM the outlet was 82,000 square feet, the velocity 2.7 feet per second, and the discharge 220,000 cubic feet per minute. At ABKLM we find the discharge necessarily 220,000 cubic feet; the outlet is 150,000 square feet, and the average velocity can therefore be only 1.5 feet per second. The water that finds an outlet across KLM, through an outlet of 10,500 feet length, 7.3 feet average depth, is in its own turn hemmed in by a second or outer basin, DEFGHI, whose crest, 210,000 feet long, is on an average about 8.4 feet below the surface of the water. At KLM the outlet was 77,000 square feet; at DEFGHI the outlet is 210,000 square feet, and the average velocity, which must be reduced accordingly, will be found to be only about six-tenths foot per second. In the same way the water that enters Bottle Channel at BK is hemmed in by an outer basin BCD, whose crest is 7,000 feet long and 7 feet deep. At BK the outlet was 38,500 square feet; at BCD the outlet is 49,000 square feet, and the average velocity will be found to be necessarily reduced to about 1.2 feet per second. Under these circumstances it is surprising that even a 9-foot channel is preserved at any point, and it becomes evident that some of this enormous free outlet must be obstructed before any appreciable improvement of the bar entrances can be effected. Before we can find the average velocity in each separate portion of the circumference of either basin, we must adopt some law of outflow. Were the sides of the basin vertical, and could the water run off outside faster than it overflows, the velocity of outflow would then be appreciably the same everywhere. Here where the sides of the basin are inclined, where the shoals are long and broad, where the winds may be strong, and where the overflowing water must push its way against nearly as high water outside, it would evidently be erroneous to suppose that the water flows as fast over shoals as through the deep channels. In such a case we will be approximately correct to assume that the velocity is nothing where the depth is nothing, least where the depth is least, greatest where the depth is greatest, and at any intermediate point is directly proportional to the depth. This simple law is probably as accurate as will bear practicable application to the flow of water over harbor bars, subjected to tides and winds of variable strength and direction.



Applying this law of outflow to the inner basin, where, at wind ebb,

AB is 5,000 feet long and 7 feet in average depth,
BK is 3,500 feet long and 11 feet in average depth,
KL is 3,500 feet long and 14 feet in average depth,
LM is 7,000 feet long and 4 feet in average depth,

we find the total outflow of 220,000 cubic feet per second, to be divided as follows:

AB, 18 per cent., with 1.1 feet per second average velocity.
BK, 28 per cent., with 1.6 feet per second average velocity.
KL, 47 per cent., with 2.1 feet per second average velocity.
LM, 7 per cent., with 0.6 foot per second average velocity.
ABKLM, 100 per cent., with 1.46 feet per second average velocity.

In the same way, in the outer basin of the Main Channel, where

DE is 3,000 feet long and 7 feet in average depth,
EF is 8,000 feet long and 7.5 feet in average depth,
FG is 3,000 feet long and 13 feet in average depth,
GH is 3,000 feet long and 10 feet in average depth,
HI is 8,000 feet long and 7.5 feet in average depth,

we find the outflow as follows:

DE, 4 per cent., with 0.4 foot per second average velocity.
EF, 12 per cent., with 0.45 foot per second average velocity.
FG, 18 per cent., with 1.0 foot per second average velocity.
GH, 8 per cent., with 0.6 foot per second average velocity.
HI, 12 per cent,, with 0.45 foot per second average velocity.
KL + LM = DEFGHI, 54 per cent., with 0.57 feet per second average velocity.

In the same way, in the outer basin of Bottle Channel, where

BC is 4,000 feet long and 7 feet in aoerage depth,
CD is 3,000 feet long and 7 feet long in average depth,

we find the outflow as follows:

BC, 16 per cent., with 1.26 feet per second average velocity.
CD, 12 per cent., with 1.26 feet per second average velocity.
BK = BC + CD, 28 per cent., with 1.26 feet per second average velocity.

The approximate accuracy of these deductions will be readily shown by comparing these deduced results as shown on sheet 12, with the observed directions and velocities of ebb as shown on sheet 3.

By supposing several different arrangements of high or submerged jetties along these different lines of outflow, and deducing the changes in outflow thereby produced, we arrive at the results shown in full on sheets 13 to 18 inclusive.

A study of these sheets shows the following roughly approximate results:

A dike across the Slough at AB will increase the outflow and consequent velocities in both Bottle Channel outlet at BC, and the main channel outlet at FG by 12.5 per cent. if the dike be submerged to 2 feet below low water, and by 25 per cent. if the dike be raised to 2 feet above low water.

A dike across the Upper Dry Breakers at CD will hardly change in any way the outflow at either the Slough or the Main Channel outlet, but will increase the velocities in Bottle Channel outlet at BC by 36 per cent. if submerged, and by 75 per cent. if raised.

A dike across the South Island Shoals at HI will hardly change in any way the outflow at either the Slough or Bottle Channel outlet; but will increase the velocities at the Main Channel outlet FG by 12.5 per cent. if submerged, and 25 per cent. if raised.

A dike between the South Island Shoals and the South Breakers along GH will hardly change in any way the outflow at the Slough or Bottle Channel outlet; but will increase the velocities at the Main Channel outlet FG by 14 per cent. if submerged, and by 20 per cent. if raised.

A dike across the Little Dry Breakers at DE will hardly change the outflow at either the Slough or Bottle Channel outlet; but will increase the velocities at the Main Channel outlet FG by 4 per cent. if submerged, and 8 per cent. if raised.

A dike between the Little Dry Breakers and the North Breakers along EF will hardly change the outflow at either the Slough or Bottle Channel outlet; but will increase the velocities at the Main Channel outlet FG by 12.5 per cent. if submerged, and by 25 per cent. if raised.

A dike across the throat of the Main Channel at DKLM will increase the velocities at both the Slough AB and Bottle Channel BC by

100 per cent. if submerged, and by 200 per cent. if raised. In either case the Main Channel will be rendered permanently unnavigable.

A dike across the throat of Bottle Channel at BD will hardly change in any way the outflow at the Slough, but will increase the velocities in the Main Channel outlet FG by 40 per cent. if submerged, and by 50 per cent. if raised.

By comparing these results we see that a high dike across the Slough at AB will do about the same work upon the main channel outlet as a high dike across the South Island Shoals at HI; at the same time AB will be much shorter and less costly, and will improve also the outflow of Bottle Channel. Moreover, this same dike across the Slough at AB will be as effective upon the Main Channel outlet as a high dike along the North Breakers at EF; at the same time AB will be much shorter and less costly. In like manner a high dike across the Slough at AB and across the South Island Shoals at GH will together be as effective upon the Main Channel outlet as a high dike across the throat of Bottle Channel at BD; at the same time AB and HI will only cost about half as much as AB and will also increase the velocity in Bottle Channel by 25 per cent. instead of closing it permanently to navigation. In like manner a high dike along the inner end of the South Breakers at GH will be as effective upon the Main Channel outlet as a high dike across the Little Dry Breakers at DE together with an extension over half ES of the North Breakers EF, and at less cost. Finally, a high dike across the Slough at AB together with a high dike across the Middle Dry Breakers at CD will be as effective upon Bottle Channel outlet as a pair of *submerged* dikes across both the Slough at AB and the Main Channel ML KD; at the same time the high dikes AB and CD, while only costing half as much as the submerged dikes AB and MLKD, will somewhat improve the outflow at the main channel outlet, instead of closing its navigation forever.

It becomes at once quite evident that but little good can be done to Bottle Channel as long as the Slough remains open; that little good can be done to the Main Channel as long as both Bottle Channel and the South Island Shoals remain open; and, further, that submerged dikes will not be as cheap and effective as usual on account of their comparatively great lengths and small height.

Owing to the exposed position of the whole line of the bar, I think that all the dikes to be built along the bar or across either Bottle Channel or the Main Channel, should be twice as wide on top as the water is deep; and that they should have side slopes of fully 1 on 3. The inner dikes at DK or LM may, perhaps, be strong enough, if made with a top once and a half as wide as the water is deep and with side slopes of 2 on 3. Moreover, from the exposed position of the bar and the rough weather preventing work for nearly two-thirds of the time, all work of dike construction will here be very expensive; and I think it will cost fully as much for labor as for material. Under these circumstances I estimate the cost of dikes as follows:

Position.	Raised to 2 feet above low water.	Submerged to 2 feet under low water.
AB	$300,000	$165,000
CD	180,000	135,000
HI	400,000	220,000
GH	370,000	240,000
DE	150,000	100,000
EF	525,000	300,000
BD	400,000	230,000
MLKD	1,320,000	700,000

With these estimates we find the following results:

(1) If Bottle Channel alone is to be improved: (*a*) A high dike across the slough at AB will increase the velocity at the outlet BC by 25 per cent. at a cost of $300,000 (see Project 4, Sheet 13). (*b*) High dikes across the Slough at AB and across the Middle Dry Breakers at CD will increase the velocity at the outlet BC by 100 per cent., at a cost of $480,000 (see Project 5, Sheet 14). (*c*) Submerged dikes across the Slough at AB and stopping up the Main Channel along MLKD or NLKD will increase the velocity at the outlet BC of Bottle Channel by 100 per cent., but at a cost of $1,000,000 (see Project 9, Sheet 18). (*d*) High dikes over AB and MLKD, stopping up the Main Channel completely, will increase the velocity at the outlet of Bottle Channel by 300 or 400 per cent., at a cost of $1,700,000 (of course this increased velocity will rapidly diminish as the depth increases under the produced scour).

(2) If the Main Channel alone is to be improved: (*e*) A high dike across the Slough at AB will increase the velocity at the outlet FG by 24 per cent., at a cost of $300,000 (see Project 4, Sheet 13). (*f*) High dikes across the Slough at AB, and across and stopping up completely Bottle Channel at BD, will increase the velocity at the outlet FG by 75 per cent., at a cost of $700,000. (*g*) A high dike across the Slough at AB, across and stopping up completely Bottle Channel at BD, and across the South Island Shoals at HI, will increase the velocity at the outlet FG by 100 per cent., at a cost of $1,100,000. (*h*) High dikes across the Slough at AB, across Bottle Channel at BD, along the inner side of the breakers at DES, and across the South Island Shoals at HI, will increase the velocity at the outlet FG by 120 per cent., at a cost of $1,500,009. (*i*) High dikes across the Slough at AB, across Bottle Channel at BD, along the whole inner side of the Dry and North Breakers DEF, across the South Island Shoals at HI, across the South Breakers at GH, and extended as necessary by submerged dikes at SW and GQ, will increase the velocities at the outlet FG by 300 or 400 per cent., at a cost of from $2,000,000 to $2,500,000, depending on the length given to SW and GQ (see Project 8, Sheet 17).

(3) If Bottle Channel and the Main Channel are both to be left open and both to be improved: (*j*) High dikes across the Slough at AB will increase the velocity at both outlets BC and FG by 25 per cent., at each, at a total cost of $300,000 (see Project 4, Sheet 13). (*k*) High dikes across the Slough at AB and across the Middle Dry Breakers at CD will increase the velocities at Bottle Channel outlet BC by 100 per cent., and at the Main Channel outlet FG by 25 per cent., at a total cost of $480,000 (see Project 5, Sheet 14). (*l*) High dikes across the Slough at AB, across the Middle Dry Breakers at CD, and across the South Island Shoals at HI will increase the velocities at Bottle Channel outlet BC by 100 per cent., and at the Main Channel outlet FG by 45 per cent., at a total cost of $880,000. (*m*) High dikes across the Slough at AB, across the Middle Dry Breakers at CD, across the South Island Shoals at HI, and across the inner end of the South Breakers at GH, will in crease the velocities in Bottle Channel outlet BC by 100 per cent., and at the Main Channel outlet FG by 70 to 80 per cent., at a total cost of $1,250,000 (see Project 6, Sheet 15). (*n*) High dikes across the Slough at AB, across the Middle Dry Breakers at CD, across the Little Dry Breakers at DE, across the South Island Shoals at HI, and across the inner end of the South Breakers GH will increase the velocities in Bottle Channel outlet BC by 100 per cent., and in the Main Channel outlet FG by 78 to 100 per cent., at a total cost of $1,400,000 (see Project 7, Sheet 16). (*o*) High dikes across the Slough at AB, across the

Middle Dry Breakers at CD, across the Little Dry Breakers at DE, across the inner end of the North Breakers at EF, across the South Island Shoals at HI, and across the inner end of the South Breakers at HI will increase the velocities in Bottle Channel BC by 100 per cent., and in the Main Channel FG by from 100 to 150 per cent., at a total cost of $2,000,000.

I think that neither Bottle Channel nor the Main Channel should be closed to navigation until the other channel has shown signs of permanent improvement.

It appears to me that much good to both channels will result from the permanent closing of the Slough at AB. Its closure is in any case the first step to the improvement of either channel, and should be done at once, whether anything further is attempted or not.

I think that the improvement of the Winyaw Bay bar entrance should be made by the use of high stone dikes, constructed in the order of the following projects:

At AB, Project 4 (Sheet 13), at	$300,000
At AB and CD, Project 5 (Sheet 14), at	480,000

If at this stage Bottle Channel shows manifest improvement CD can be economically and advantageously extended seaward to the 15 or 18 foot depth. If the Main Channel shows manifest improvement the work can progress as follows:

At AB, CD, HI, at	$880,000
At AB, CD, GH, HI, Project 6 (Sheet 15), at	1,250,000
At AB, CD, DE, GH, HI, Project 7 (Sheet 16), at	1,400,000
At AB, DE, SW and IH, GA, Project 8 (Sheet 17), at	2,500,000

I have therefore to recommend the sum of at least $300,000, as an amount that can profitably be expended upon the improvement of Winyaw Bay Bar entrance, IC, in the construction of high stone dikes across the Slough and around the inner edge of its bar, as may be shown necessary during the progress of the work.

Very respectfully, your obedient servant,

W. H. BIXBY,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.
(Through Lieut. Col. W. P. Craighill, Supervising Engineer.)

[First indorsement.]

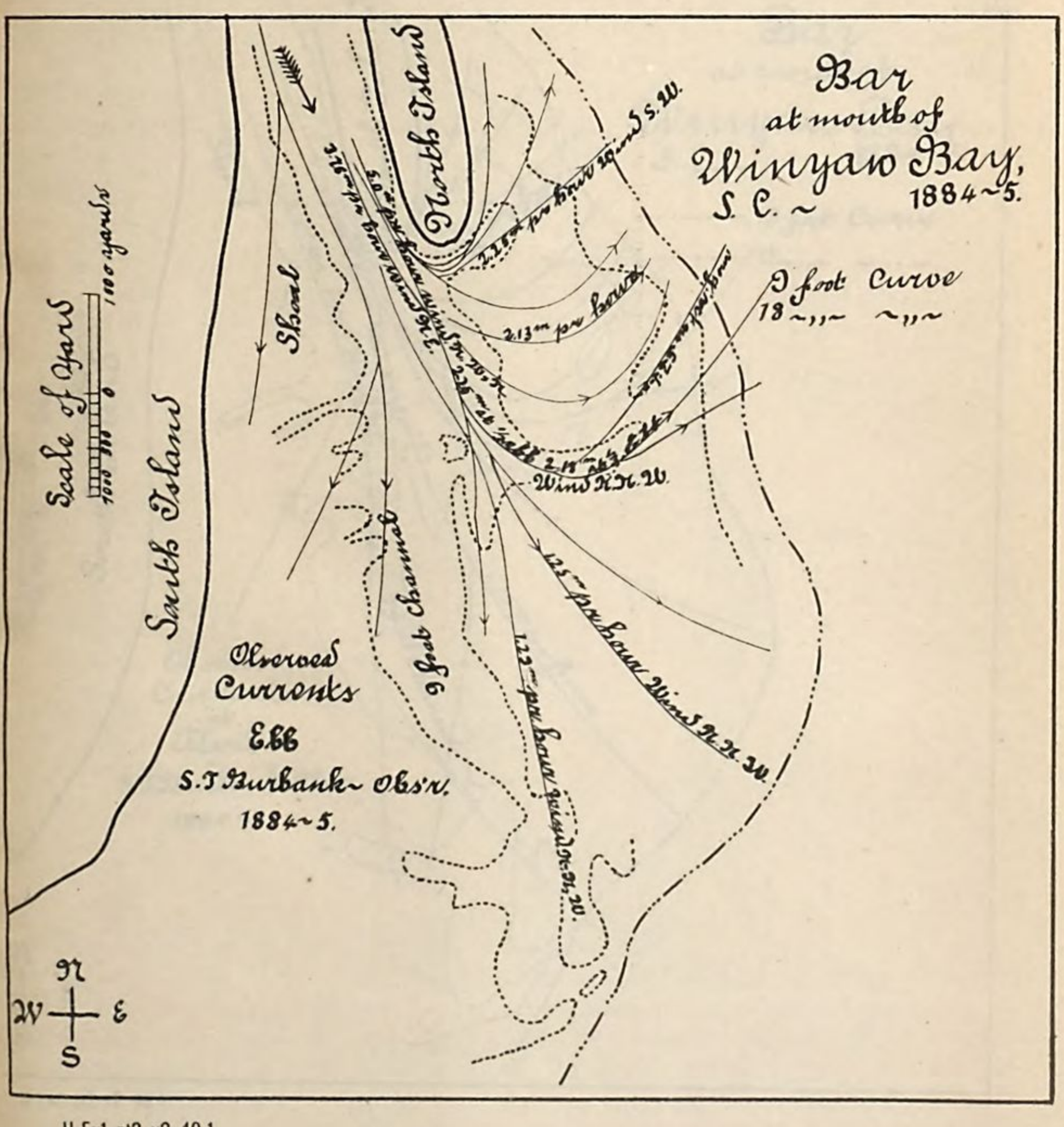
UNITED STATES ENGINEER OFFICE,
Baltimore, Md., February 20, 1885.

Respectfully forwarded to the Chief of Engineers.

The problem herein presented is a very interesting one, and is well treated by Captain Bixby, as also by his predecessor, Captain Mercur.

Before a final opinion can be given as to a choice in the direction of efforts to improve the main entrance of Bottle Channel, further investigations as to littoral and other currents and other matters are necessary. I agree with Captain Bixby as to the practicability of a sufficient improvement of one or the other of these entrances by the use of jetties, low or high. The commercial interests involved justify such an improvement.

It seems clear that a dike to close the Slough at foot of North Island is an essential part of any improvement. If means were available I should recommend the immediate construction of a low dike on or near the line AB, Sheet 14, to be raised as soon as practicable to a height of



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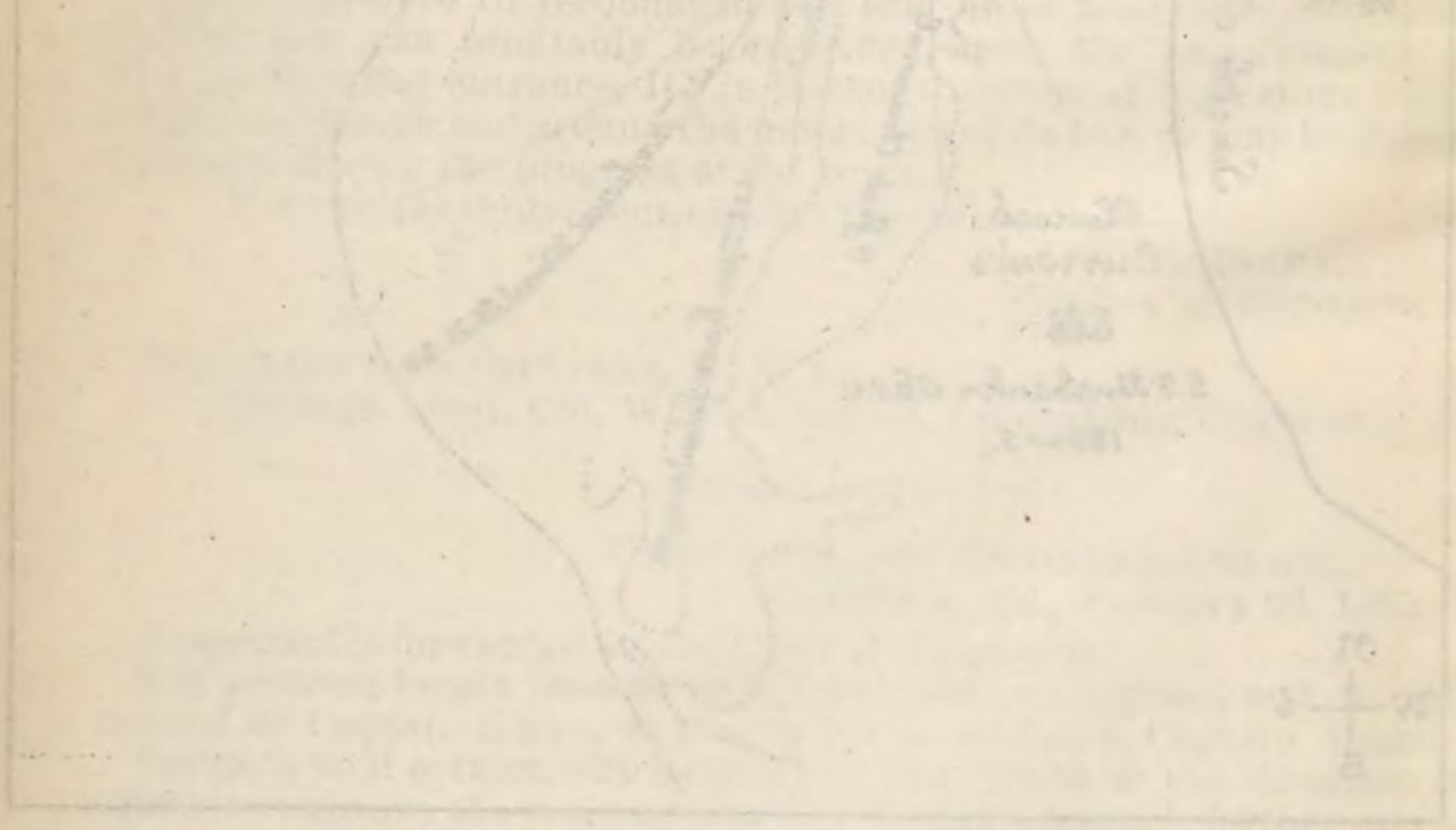

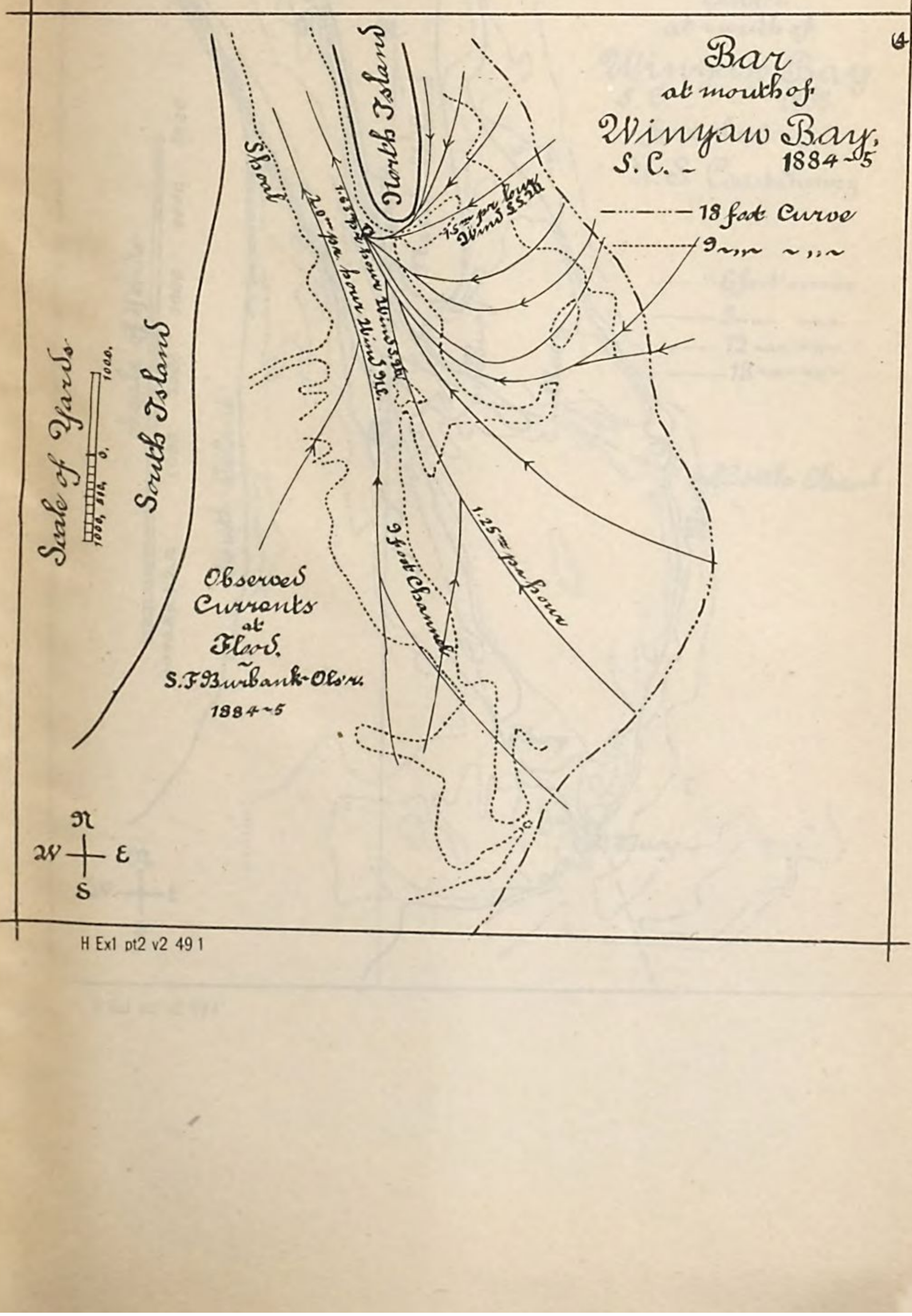

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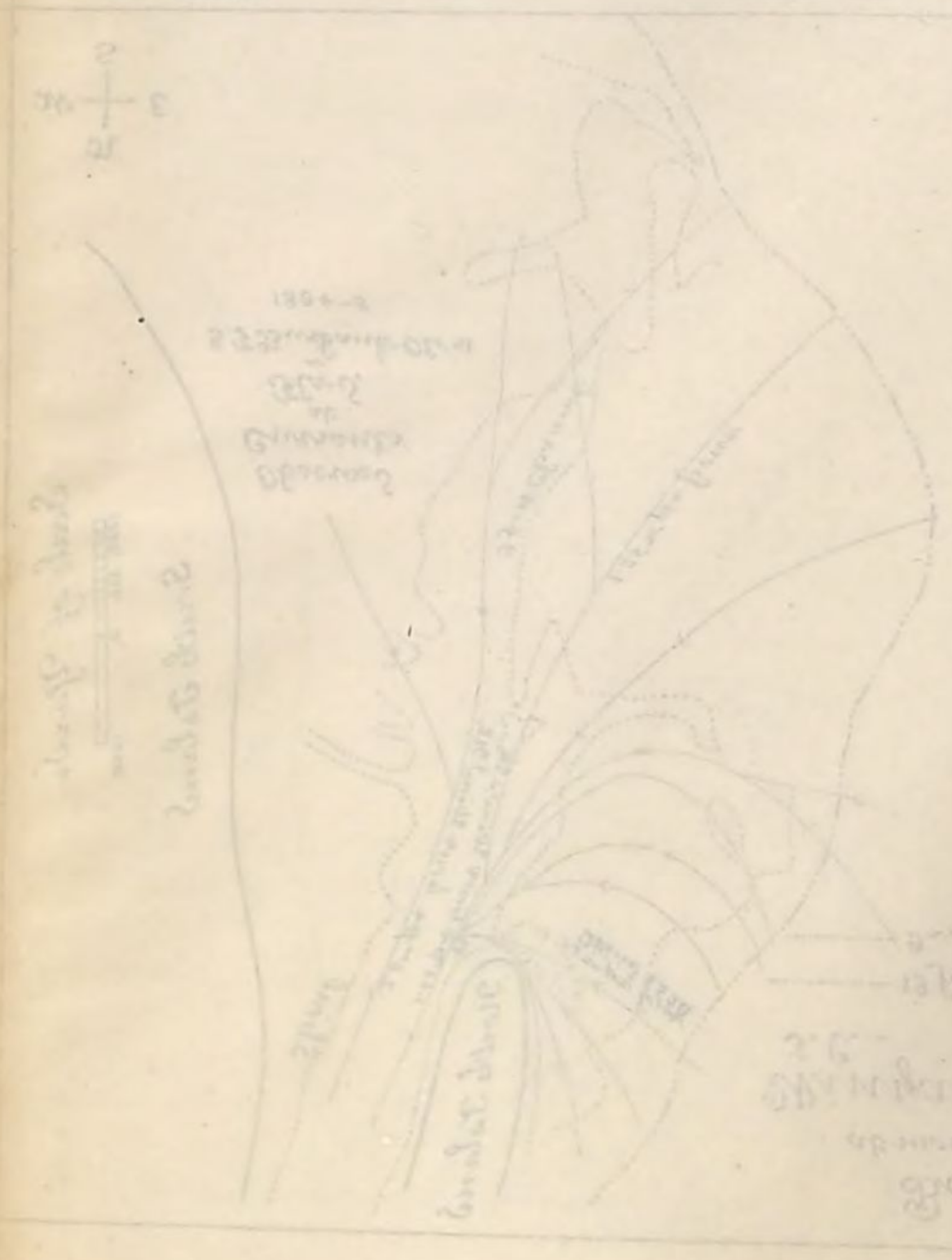

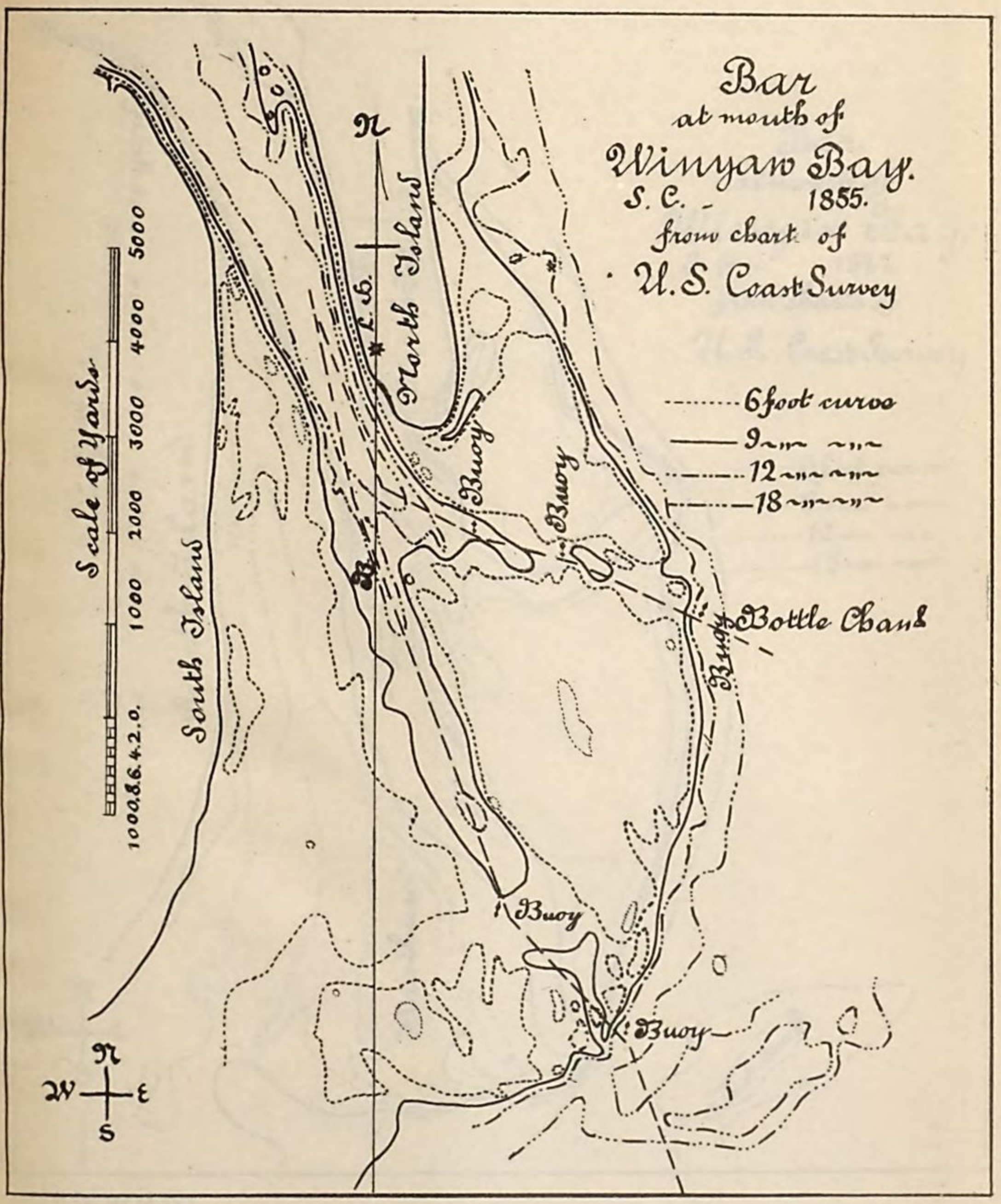

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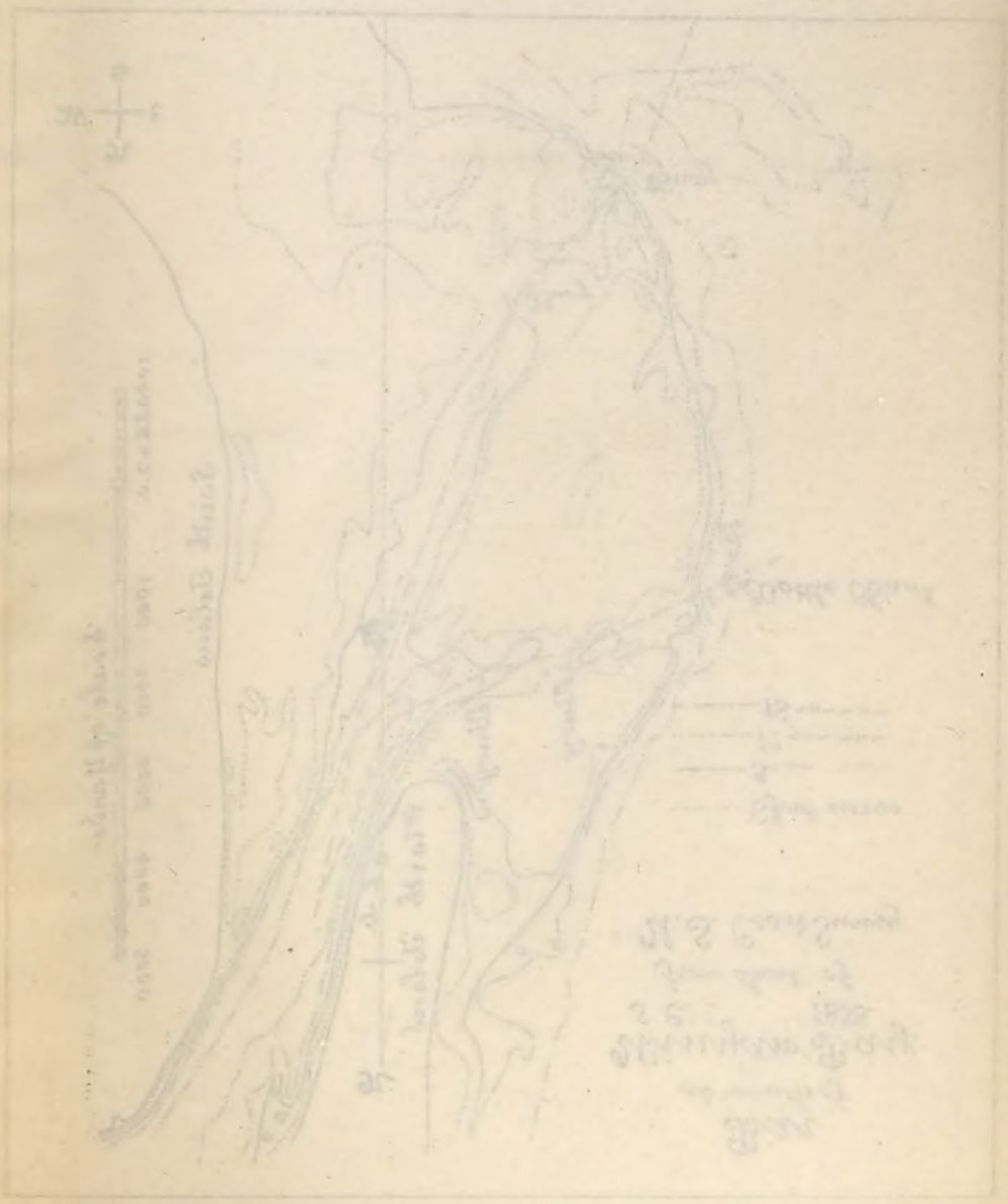

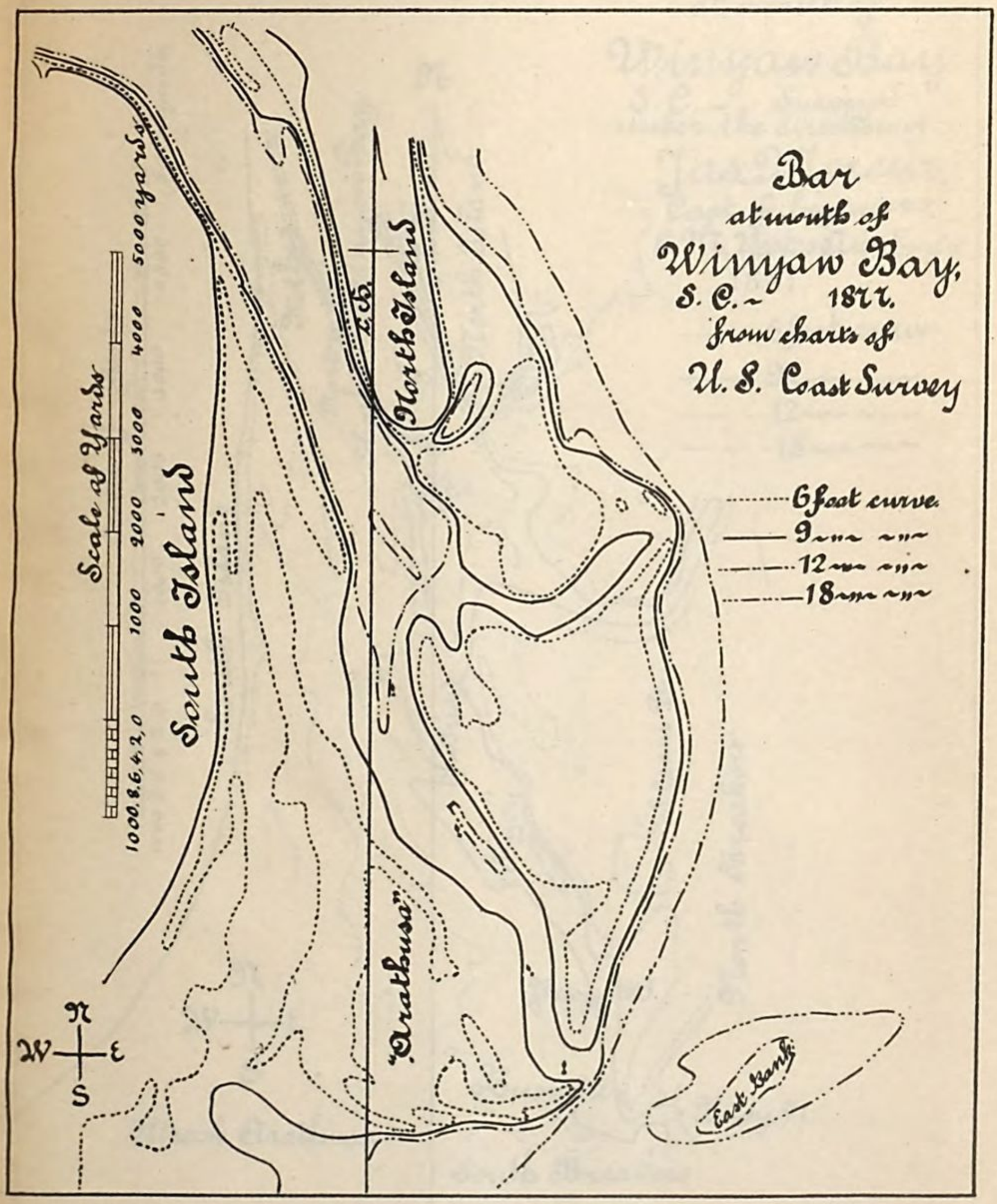

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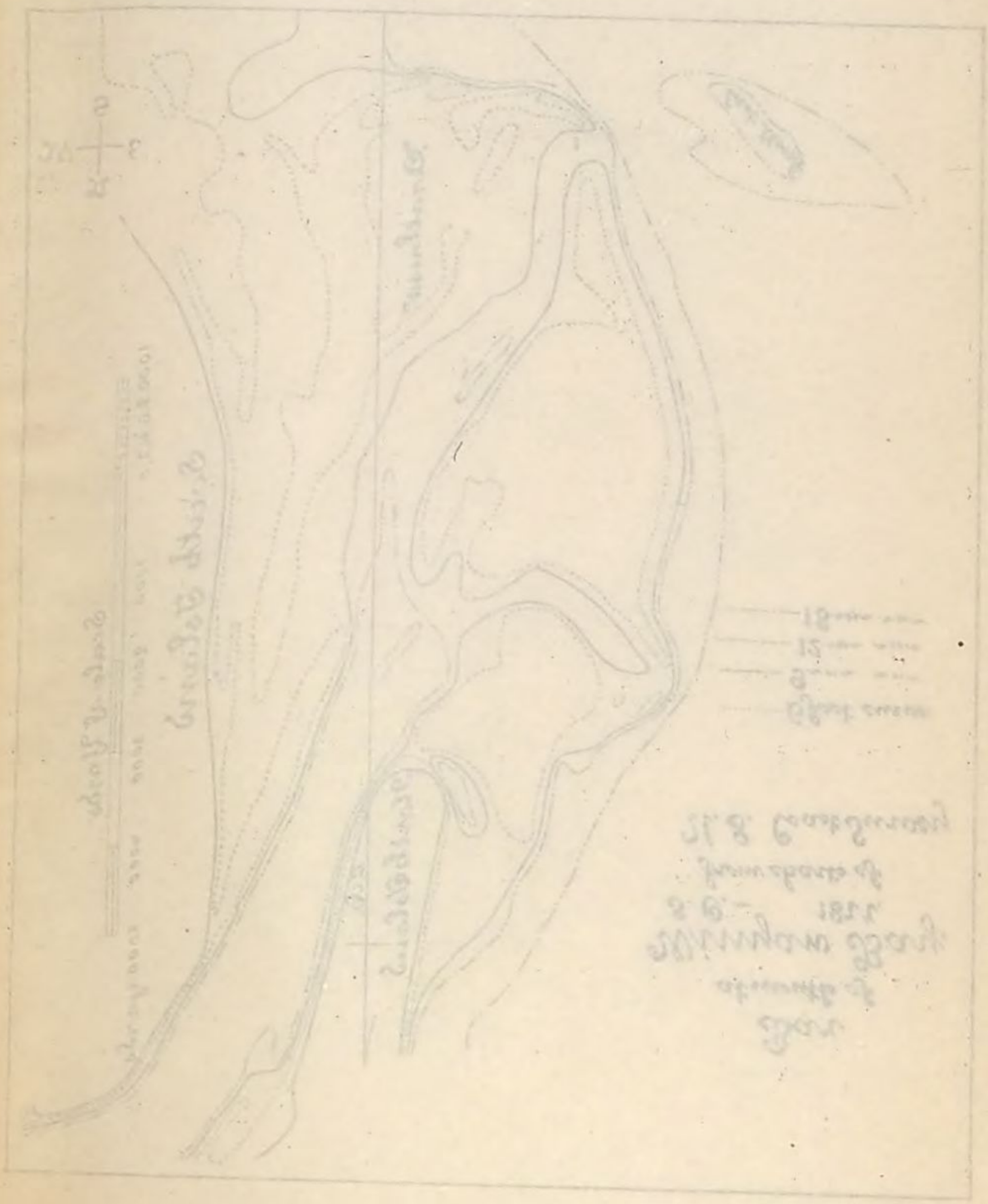

Bar at mouth of Winyaw Bay

S.C. — Surveyed under the direction of Jas. Mercur, Capt. of Engineers C.M. Yeates Asst. Engr. 1881.

6 foot curve
9 " "
12 " "
18 " "

Scale of Yards
1000 0 1000 2000 3000 4000 5000 yards

North Islands
South Islands
Mathews
Winyaw Bay
Shoal
Buoy
Buoy
North Island
Buoy
Buoy
Steam Drum
North Breakers
Buoy #3
Buoy #2
Buoy #1
South Breakers
Wreck Arathusa

N
W E
S

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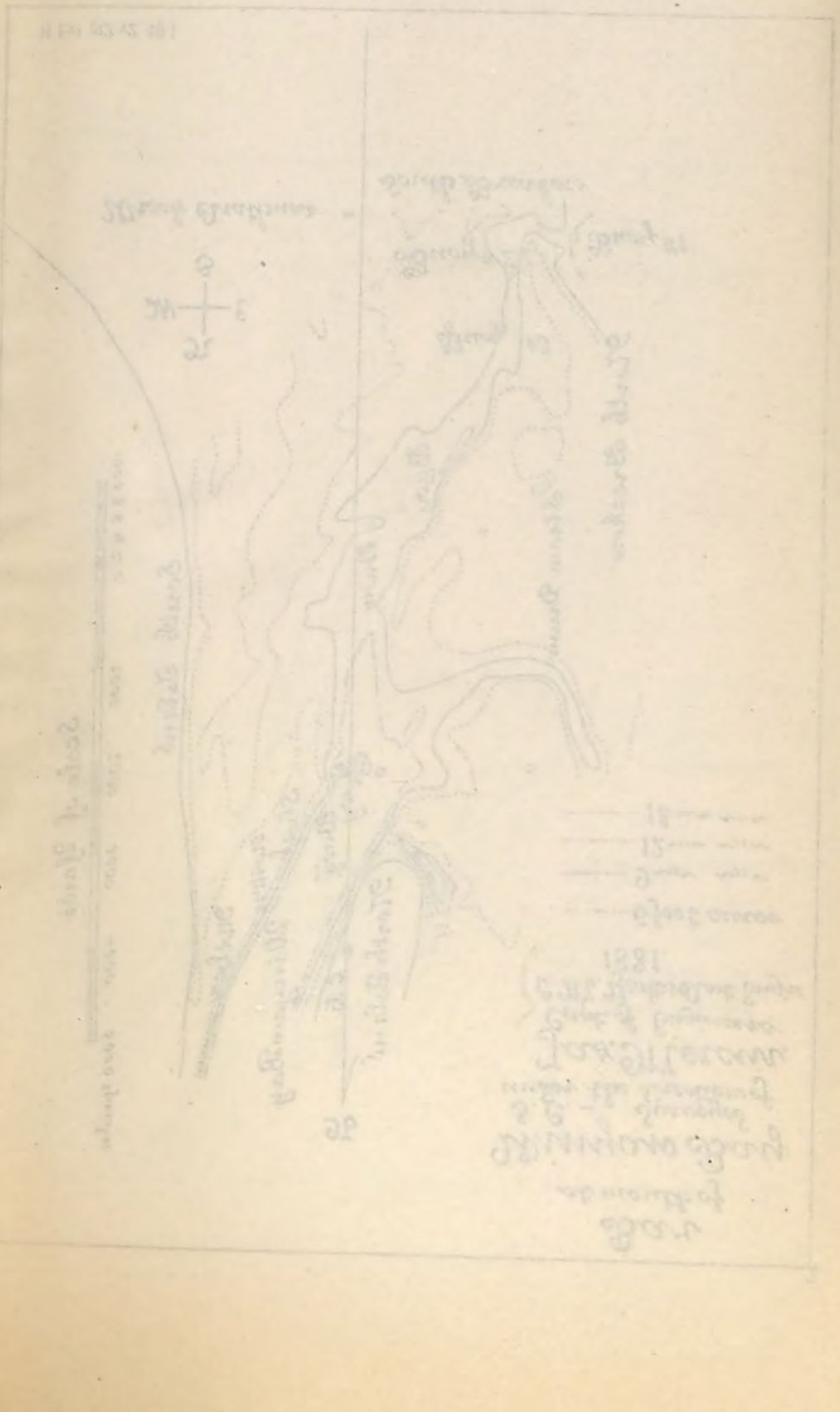

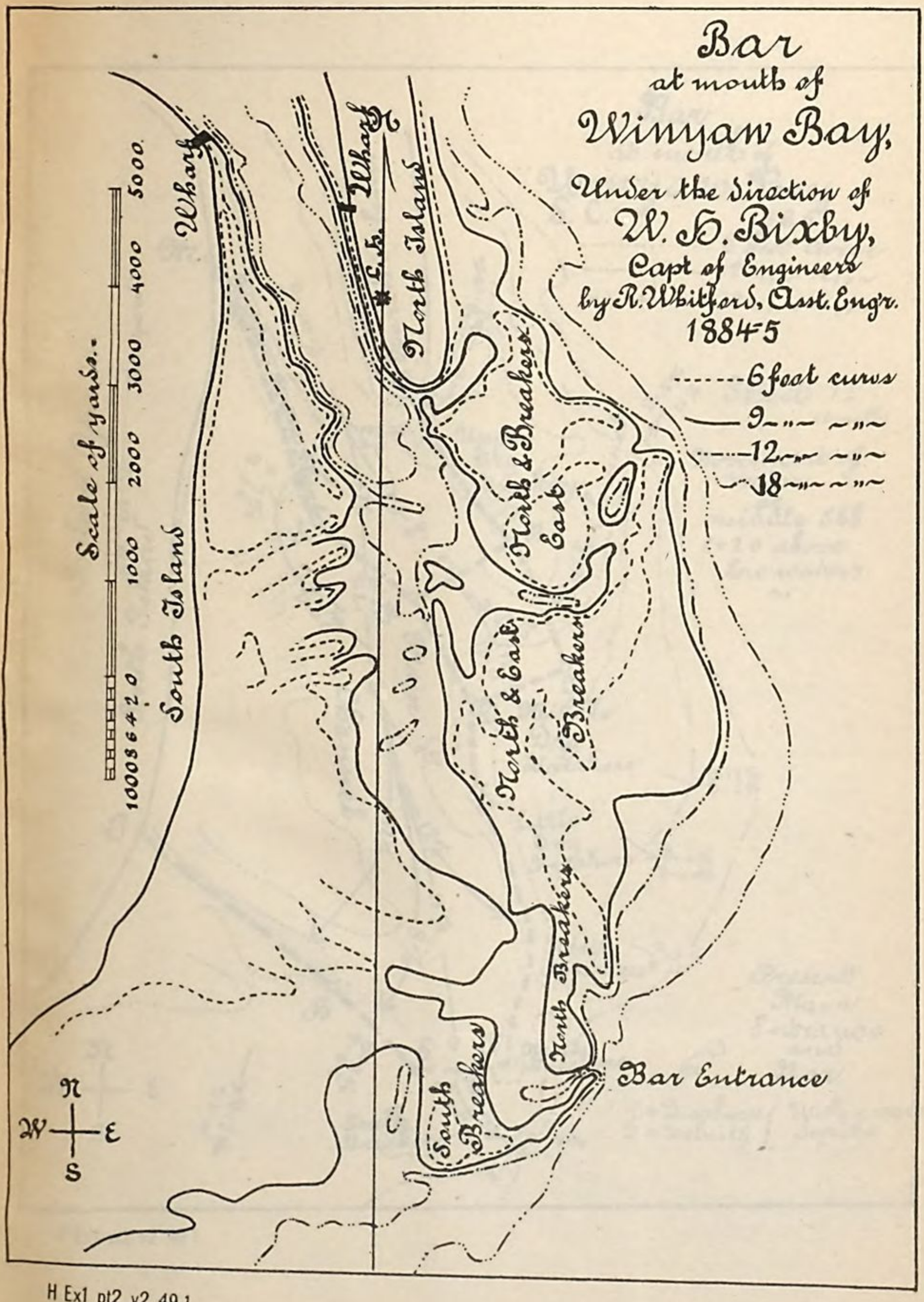

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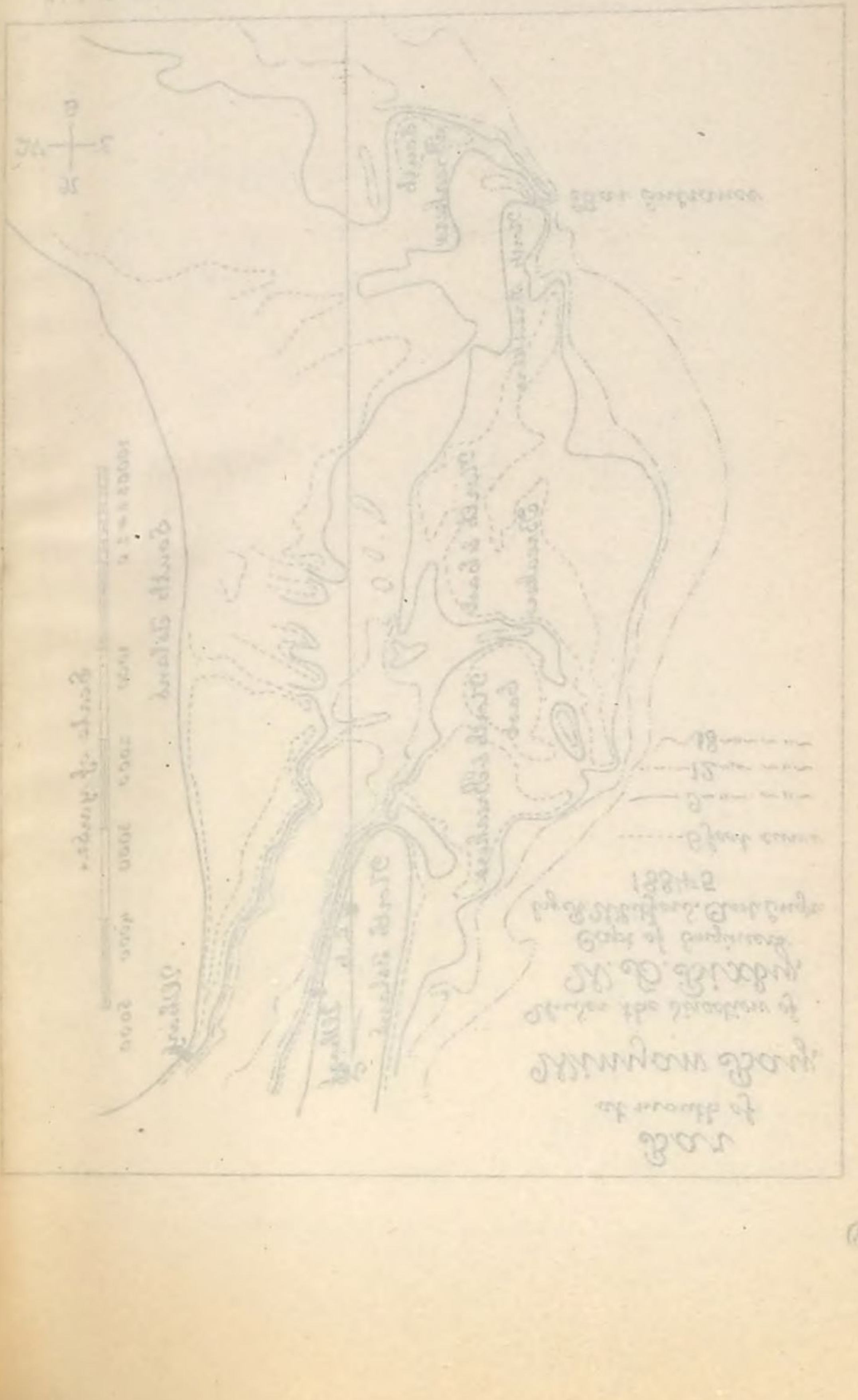

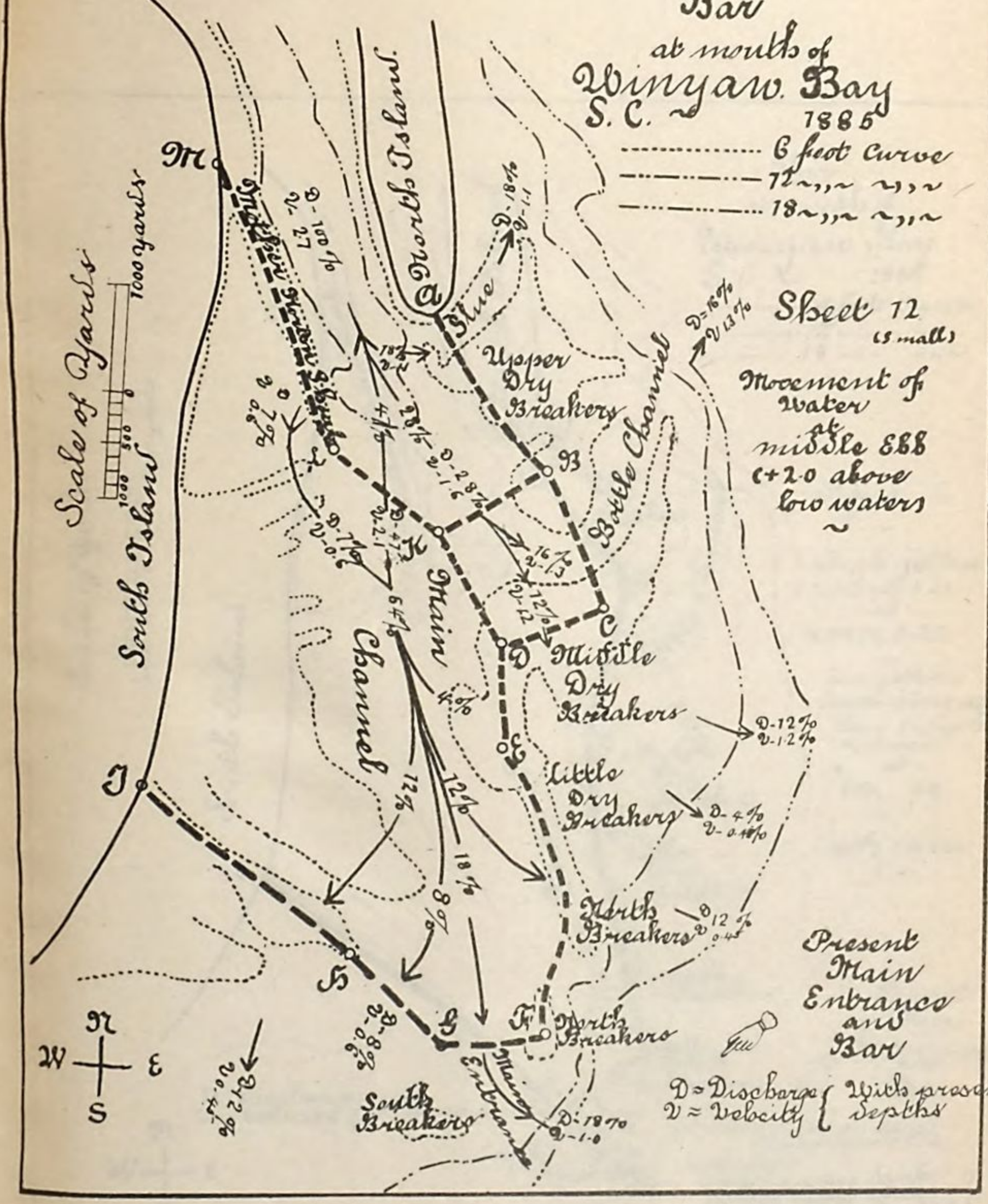

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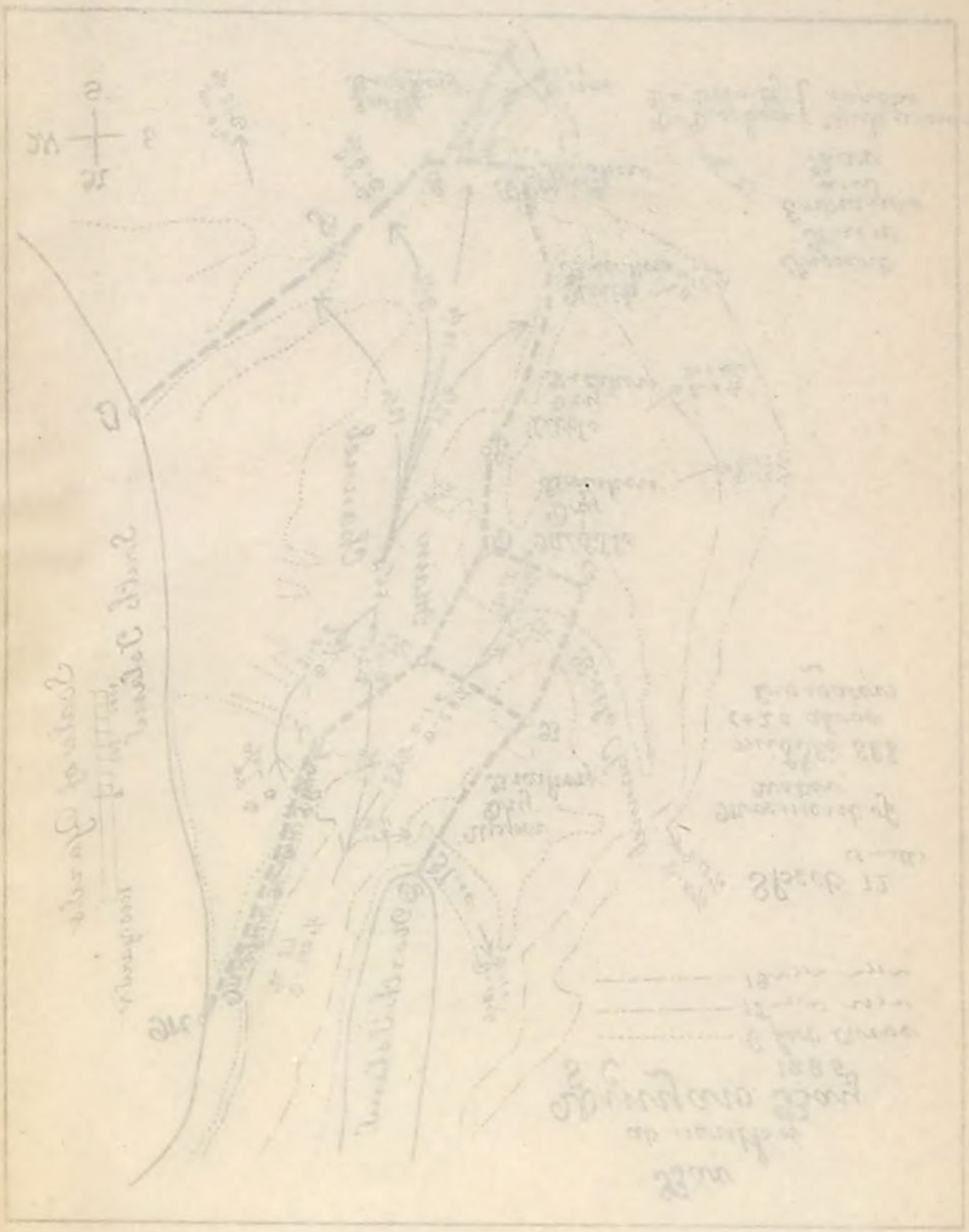

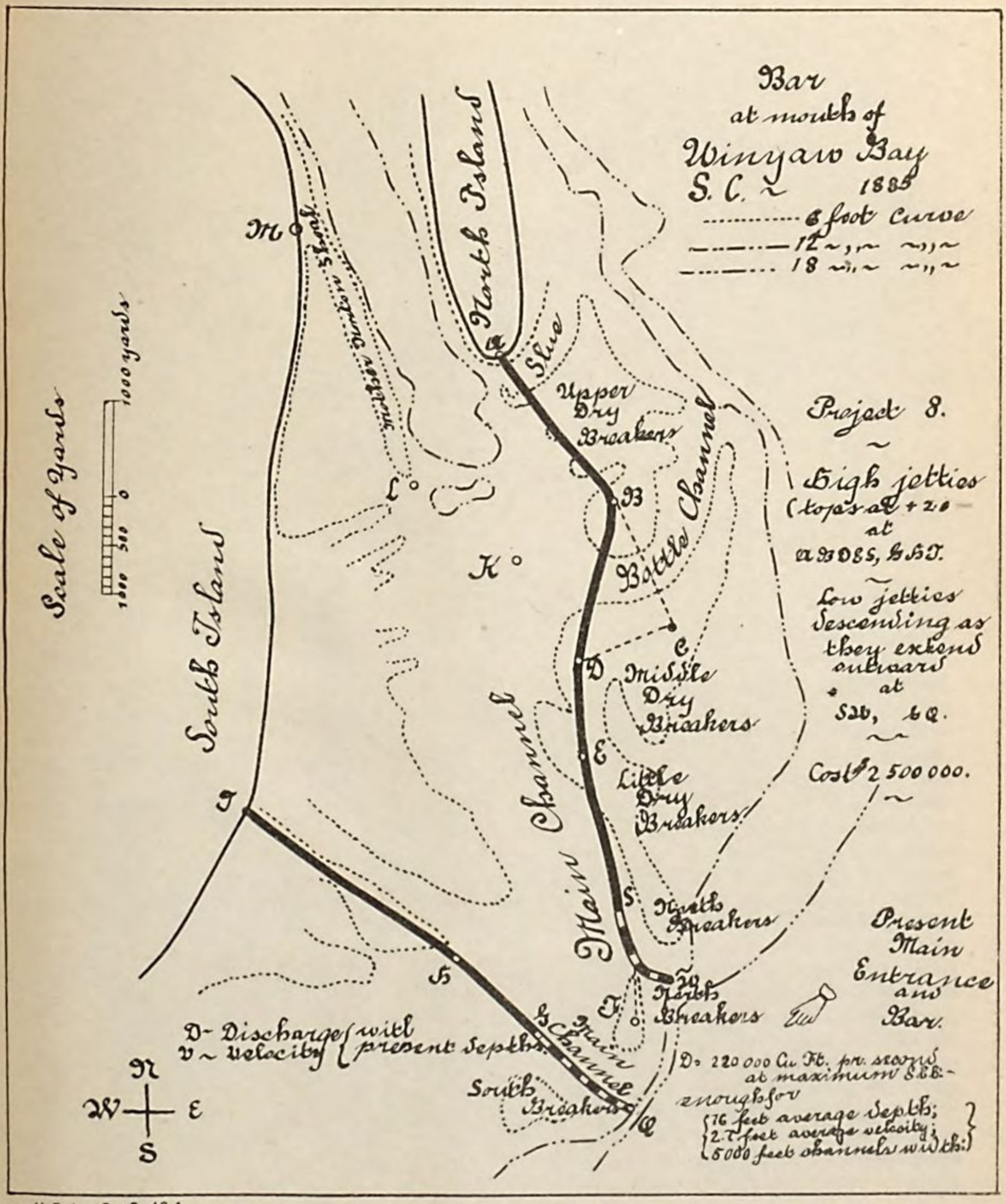

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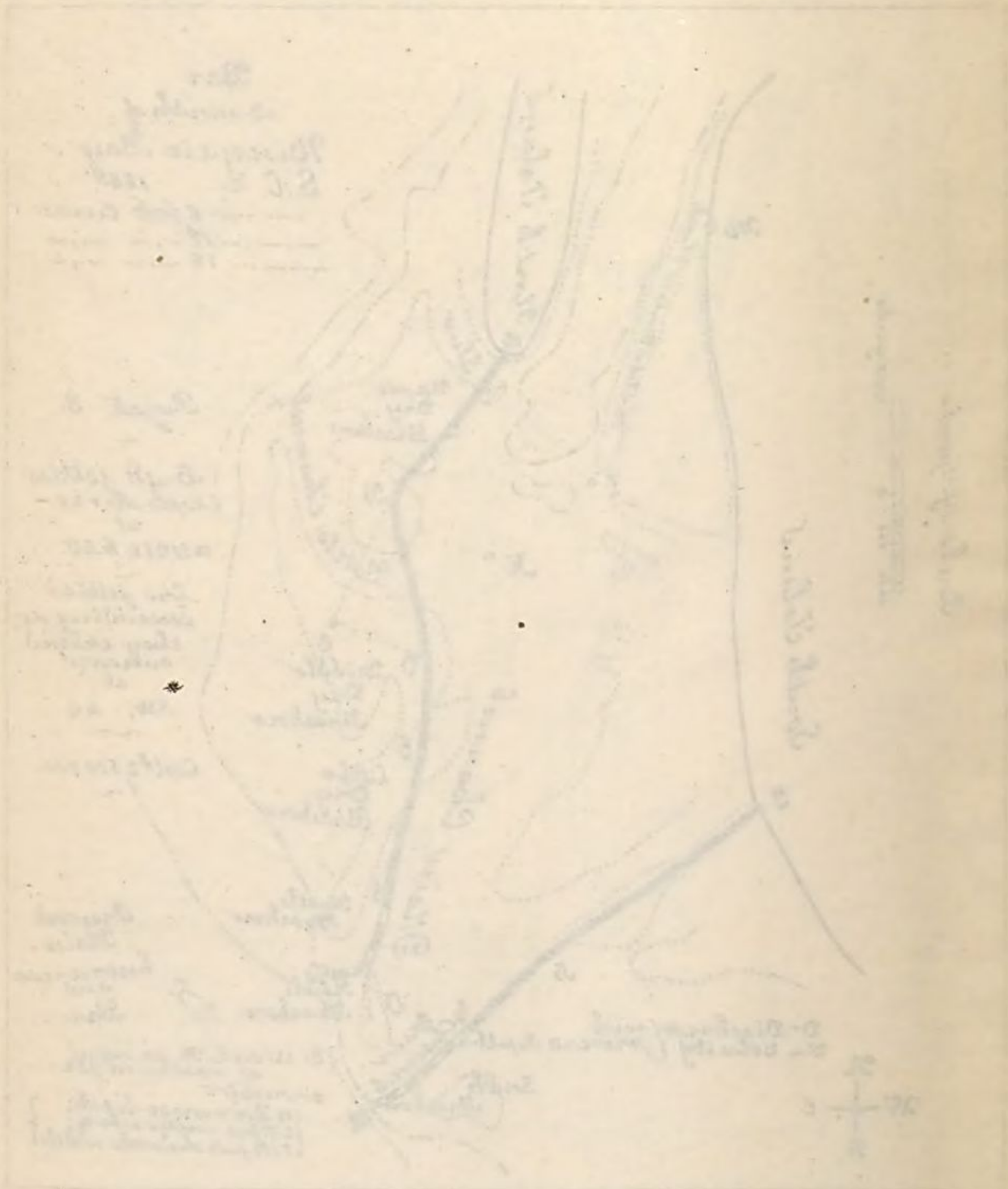


about 2 feet above low water. The effects of this structure should be carefully watched. Thereafter a decision should be made as to location and character of other works to deepen Bottle Channel *or* the main entrance.

WM. P. CRAIGHILL,
Lieut. Col. of Engineers.

REPORT OF MR. REID WHITFORD, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Georgetown, S. C., January 17, 1885.

CAPTAIN: I have the honor to submit the report that follows with accompanying maps, relating to the survey of the entrance to Winyaw Bay, South Carolina, made in obedience to instructions contained in your letter of November 28, 1884.

The object of the survey has been to collect such information as might be necessary to determine the practicability of deepening the water on the bar at the entrance to Winyaw Bay, and to form projects for accomplishing the same.

A party was organized as early as possible, and by the 9th of December they were in the field, regularly at work, with quarters at South Island. From that time operations continued under the serious disadvantage of most unfavorable weather, high winds, rough water, dense fogs, and intense cold, causing many perplexing delays. Every hour that could be utilized was judiciously employed, and the work rigorously pressed. The southeast end of South Island Wharf was made the initial point of the survey, from which stadia distances were measured down the shore to Santee Point; also, on North Island side, opposite the wharf, to and around North Island Point, up the sea beach for about 2 miles. Along these lines at convenient distances flags were set for the termini of sounding lines. Base lines were carefully measured by means of steel tape, and checked by stadia observations on both shores. The one most used was located on the lower end of South Island, and had a length of 6,393 feet. There was also a calculated base, extending from South Island to North Island, which was used when the sounding boats were in certain positions, in order that better conditioned triangles might be obtained.

The location of our own range buoys, the permanent buoys belonging in the entrance and other fixed objects, as well as each position of the sounding-boat were ascertained by transit angles from base lines.

A number of pointson South and North islands, including the center of Georgetown light-house, L. P. Miller's residence, the Trenholm dwelling house, L. P. Miller's old rice-mill chimney, and Lowndes rice-mill chimney (the latter near Mosquito Creek), were made triangulation stations, to which the shore-line stations were connected. Angles and bearings were plotted in the usual manner, with a vernier protractor, reading to three minutes. Soundings were recorded every one-half minute by the watch, every fourth one being located by simultaneous transit angles, such lines having been checked at their beginning and ending, and at occasional intermediate points, by liquid compass bearings to two or more of the triangulation stations. Besides, the direction of each line was kept by courses read from the liquid compass. Radiating from buoys above mentioned, numerous lines of soundings were taken to the shore flags and extending to the 20-foot contour at sea, as represented on map. The plane of reference to which soundings are reduced is mean low water, and was determined by recording and averaging all the low waters covering a period of a full lunar month of twenty-nine days. The mean rise of the tide, above that plane, was also arrived at by averaging all the high waters in same manner. While we have used every care possible under the circumstances to furnish correct soundings, still they may differ somewhat from those taken during calm weather in smooth and slack water. In order that this work might be closed up within the limited time allowed, we could not wait for such days as would be best suited for sounding the sea and shoals bordering thereon. It is believed, though, that the hydrography presented, upon the whole, is about correct, more especially through the channels and over such portions of the shoals as might be embraced within projects likely to be found, having in view the future deepening of the entrance. Several attempts were made to thoroughly sound "The Breakers," but it could not be correctly done because of the roughness of the sea. A calm time will be required to secure the least depth of water at such places.

TIDES.

Their mean rise and fall is found to be 3.5 feet, and greatest (from highest to lowest) 6 feet.

The duration of the ebb current is about seven hours and twenty minutes, against five hours and twenty minutes flood. However, these figures are subject to marked changes since, as I am informed by good authority, that when there are freshets in the rivers emptying their waters into Winyaw Bay, the volume of fresh water thus brought down is so great that it produces an almost constant fluvial current, allowing but little, if any, rise of the incoming tides. Furthermore, when strong westerly winds prevail, there is scarcely any rise of the flood, but greater strength and longer duration of the ebb.

CURRENTS.

A line from RRR to WWY (see Sheet A) across the throat of the bay was selected for a cross-section. (See Sheet B, herewith sent.) From it numerous lines of current velocities were followed up in various directions (as shown on Sheet C), the position of the observer's boat being located by sextant angles, measured to three or more of the triangulation stations, and the velocities determined by submerging a current meter, attached to the end of a small wooden beam projecting so far over the bow of the boat as to be beyond the reach of any interference that the boat might have with the flow of the water. As a check upon the velocities registered by this instrument, a ship's old-fashioned log and line, graduated into knots by simple proportion, was used, and the one found to agree with the other. At the beginning of the ebb the current flows straight down the throat of the bay over Mother Norton's Shoal till it reaches the point of North Island, where a portion of it separates from the main body, running around North Island, and thence going to the northeast. The main body continues on till it arrives about at the Fishing Bank buoy, where a separation again takes place, and this portion runs somewhat to the south of east till it strikes the mouth of Bottle Channel, where it again changes its course and runs about northeast through said channel till it reaches the 20-foot contour, where it becomes greatly reduced in strength, but still continuing in the same direction. The main body flows on about south till it approaches the Outer Bar entrance, goes over the outer bar in a direction of about from east to southeast, returning to the same point in the throat, when the ebb current is at its strength; again it separates at North Island Point, and a large volume rushes around it with great force in same direction as in beginning, till it reaches a point to the north, where it spreads and slackens, but continues in a northerly direction up the coast. Now, also, a larger body is deflected to the left in a southeasterly direction by Mother Norton's Shoal, till it strikes the shoal north of the inner mouth of Bottle Channel; it then follows rapidly around the shoal and enters Bottle Channel, running about northeast. The current to the west of Bottle Channel continues down the Main Channel about south to the Bar, and then from southeast to east. It is believed, from as thorough observations as could be taken, that no matter what the prevailing winds may be, the ebb currents will flow through the Bottle Channel in same direction, and also around North Island. It is not so certain that it retains the same course over the outer bar contrary to the winds, for by the time it arrives there it very probably has become so much weakened by its long run from the throat and by the waste to right and left over the shoals through North Island Point Slough and Bottle Channel, that it has not sufficient strength left to resist their force. The greatest velocity of the ebb on the cross-section line observed was 3.75 miles per hour; wind northeast; fresh tide about 0.75 out. Greatest in the throat, 5 per hour (rare occurrence), just above the point of separation of tides at North Island Point; wind northwest—strong; tide about 0.75 out. In the Slough around North Island, 2.25 miles per hour; wind southwest—strong; about last of ebb. Greatest in Bottle Channel, 2.18 miles per hour; tide one-half ebb; wind north-northwest—very light. At outer mouth of Bottle Channel, at the 20-foot contour, a current of 1 mile per hour was observed going to northeast; wind very light—southwest. In Main Channel at Fishing Bank Buoy, ebb observed 2.25 miles per hour, running south-southeast; wind north; strong tide, about 0.75 out. In Main Channel at Inner Bar buoy, ebb observed 1.28 miles per hour, running south one-half east; wind northeast—strong. Strongest flood observed in throat of bay, 2.30 miles per hour; wind east—light; tide about 0.75 in. In Bottle Channel, flood observed 1.25 miles per hour; tide about 0.50 flood; wind southwest—light; tide running straight for throat of bay. In North Island Point Slough, observations 2.12 miles per hour; tide 0.25 in; wind south-southwest—strong. In Main Channel at Fishing Bank buoy, flood observed, 1.9 miles per hour; tide about three-quarters in; wind northeast—strong; running into throat at harbor with Bottle Channel current. At Outer-Bar buoy the first of the flood was observed going east-northeast; light wind, south-southwest. The same was noted at the sea buoy, and at Slough buoy, about last of flood, setting northeast; wind south-southwest. A much more thorough examination of the currents was desired; but more time and better weather are needed for this purpose. Unfortunately, we were unable to observe the greatest velocities of the tides outside the harbor, for the reason that their strength is reached when the winds are so high that it would have been inexpedient to use a small open boat on the outside.

In regard to the "suspected existence of a constant littoral current" in this vicinity, I have to say that every effort within our powers, under the circumstances, has been used to decide that question; but it can only be done positively by a more extensive and thorough and systematic series of current and tidal observations than we have been able to complete in so short a time. However, all information by actual experiments and inquiries on the subject that have been collected leads to the following general conclusions:

The ebb currents, after escaping from the throat of the bay, radiate in lines running off shore from the southeast to northeast, till their strength is expended in the sea. Now, it is thought very probable that the flood currents return to the entrance and through the throat, approximately, on the same lines. In that case the incoming current would come in contact with the North Island beach, at a point some distance above the Georgetown light-house, where it likely seperates, one portion running to the northward, with very little strength, and the other going to southward, with greater rapidity, thus forming a littoral current till it is drawn into the throat of the bay around North Island Point. Another body would strike straight into the outer mouth of the Bottle Channel on one of the radiating lines, another across the Outer Bar entrance, and so on till beyond the attractive influence of the bar entrance, after which it enters to the mouth of the Santee River. Certainly the direction of the lines of the incoming currents must be more or less affected by the force of the prevailing winds, more especially on the surface of the water before the currents have reached their greatest velocities. It is very likely that the heavy northeast winds at the time of the flood, sweeping down the North Island beach, produce a littoral current of sufficient power to wash away and carry with it the sand-dunes bordering on the sea, to be deposited at some place to the southwest. The writer has observed that the erosion of the sand-dunes, above mentioned, has been considerable. The courses of the flood currents at some of the outer buoys in the entrance, heretofore given, were taken by the undersigned with a liquid compass at a time when said currents were not at their strength. Sheet C, accompanying this, illustrates the general directions of the currents, in and out of the entrance, as observed in the limit represented by velocities given.

The flood current, which is shown as running in from the direction of the Santee River, is supposed to divide from the current going into that river just to the southwest of the Outer Bar entrance. At present there are in the Slough around North Island about 7 feet; in 1881, Captain Mercur's survey, the depth was about 7 feet; in year 1877, Coast Survey chart, there was 7 feet; in the year 1866, by authority of the pilots, there was only 2 feet, and the Coast Survey chart of the year 1855 gives a depth of only 4 to 5 feet. At present the controlling depth in Bottle Channel is on the very narrow bar at its outer mouth, which is about 6 feet; general direction of channel northeast; in year 1877. Coast Survey chart, the depth was about 6 feet, and the direction about northeast; from the year 1866 to 1876, depth reported by the pilots 8.5; direction about the same; and, also, it is stated positively by one of them that he sailed at high water without the use of a tug, a vessel drawing 13 feet, through the Bottle Channel. At this time, as before stated, there was only 2 feet around North Island, and I am informed the depth on the Outer Bar became reduced to 5 feet. Up to and for several years preceding the year 1876, the shoal on the north side of Bottle Channel, where there is now from 3 to 4 feet, was so high that at each low water its top was well above that level, but about the year 1876 the shoal became no longer visible, having been swept away by the violence of a northeast storm. Then the depth was lessened to 6 feet, and so it has remained till now. ' At the time of the decrease of the depth in said channel, the outer bar was opened to 7.5 or 8 feet by the same storm, and the Slue around North Island also opened to 7 feet. All the above is information obtained from the most trustworthy and intelligent pilots in the harbor. In the year 1855 the Coast Survey chart gives a depth of 7 feet in Bottle Channel, and its direction southeast. The chart states that "this channel is a recent washing of the ebb current, and that it continues to improve in depth and directness." Our survey finds a depth of 8.9 feet on the Outer Bar, and direction of channel about east. In the year 1881 Captain Mercur's survey shows 8.3 feet; direction unchanged. The Coast Survey chart of 1877, 7.5 to 8 feet, direction still unchanged; and in 1855 the depth was 8 feet and the direction southeast. It would seem that the channel outlets to the sea show an inclination to work to the north and east, or on a line with the prevailing winds. On our map will be seen a Slough at Outer Bar entrance, the washing out of which is of recent occurrence, and is not represented on any previous map of the bar. Its direction is about southeast, one-half east, from North Breaker buoy through South Breaker Shoal. It furnishes a depth of about 7.3 feet, and is said to be slowly deepening, which has a tendency to lessen the Main Bar depth. However, this is thought not to be permanent, and may fill up again in the season of heavy southwest or west winds. On account of its narrowness it is not much used by vessels, but one drawing about 11 feet and 10 inches a short time since was safely carried through it at high water. All depths given refer to mean low water when not

otherwise stated. The natural features of the locality would indicate that an outlet to the sea might be deepened by artificial means. The broad expanse of Winyaw Bay acts as a "catch basin" or reservoir for the vast volumes of fresh water which are being annually poured into it from the numerous water-courses with which it is connected.

Through the narrow throat between North and South Island all this water, together with the flood, must pass and be discharged into the sea. Now, the flow of the water is generally accelerated by its narrow contraction in the throat, and consequently the scouring action upon the bottom produces and retains a largely increased depth. Immediately upon the water escaping from the throat at either end the velocity of the current materially slackens, and hence deposits and shoals. If the same conditions could be reasonably brought to exist by artificial means below the throat, or, in a word, continue and finish what nature has left unfinished, why would not the same result be acquired? As the duration of the ebb is longer than the flood the scouring action in the direction wished for will, it is thought, more readily accomplish the end in view. Should you decide to form a project looking to deepening of an outlet to the sea it is respectfully recommended in so doing you take into consideration the advisability of using the Bottle Channel for this purpose on account of the following reasons: It offers the shortest and most direct route to deep water, and consequently is cheapest. It lies about on the line of the natural flow of the tides, and in the course of the prevailing winds, which are from the northeast and southwest, and would be, it is believed, more easily deepened and more permanently kept open.

Being in close proximity to the throat of the bay it naturally receives the full benefit of the scouring action of the accelerated current projected therefrom before it has traveled too great a distance to expend its force and be shifted at will of cross winds. It has been once used as the regular passage for vessels. The sand-bar at its mouth is, in comparison, very narrow and very near to deep-sea water. The character of the bottom in the channel is sand, and it is thought that it would not successfully resist the scouring action of an increased out-going current.

It has been noticed that the depth in Bottle Channel was greatest when that in Slue around North Island was least, and *vice versa*, which would go to prove that were this waste of water diverted from the Slough and turned into the Bottle Channel the result might be a restoration to its former, with probably an increased, depth.

That which follows has been copied from the report of the recent preliminary examination of the bar, showing why the entrance is thought to be worthy of improvement.

The passage now being opened via Mosquito Creek, between the Santee River and Winyaw Bay, will connect this bar with about 965 miles of navigable water-courses for light-draught steamers, as follows:

	Miles.
Waccamaw River	200
Great Pee Dee	216
Santee River	184
Wateree and Congaree	110
Black River	55
Little Pee Dee, Sampit, and Lynch rivers, and Black Mingo Creek	200
Total	965

These rivers all flow through an exceedingly fertile farming country, and are bordered by an almost inexhaustible supply of every variety of timber known in the Southern States.

The opening of the Congaree will give Columbia, the capital of the State and a flourishing city, situated in the center of the cotton belt and at the head of navigation of that river, direct water communication with Winyaw Bay, Georgetown Harbor, &c., and by opening the Wateree to Camden, a growing and important town, also in the cotton belt, the same communication will be promoted.

Much freight will naturally seek an outlet over these highways via Winyaw Bay and the bar.

The Great Pee Dee and the Waccamaw are also rivers of importance, upon which commerce is yearly increasing, and a still greater impetus will be given them as they are cleared of obstructions and opened to free and safe navigation. With these facilities for cheap water transportation and the many resources of the country there is no reason why Georgetown Harbor should not become a point of considerable commercial magnitude

Sufficient depth of water on the bar is the key which alone can open the door to this entire and splendid system of river transportation. Safe and uninterrupted navigation will encourage the capitalist to invest his means in sail and steam lines to Northern cities and foreign ports. No stronger argument can be adduced to prove the present uncertainty of navigation over this bar than the fact that, during the

writer's short residence at South Island, he has known vessels drawing no more than 12 to 13 feet to be detained for two weeks awaiting a flush high water to take them over; and, further, the schooner B. J. Hazard, owned in Georgetown, and drawing 13 feet, was not long since detained twenty-three days from the same cause, losing not only the entire time of a trip to New York, but also incurring a loss to her owners of at least $800. However great distress a vessel may be in while approaching this bar, no tug drawing over 7 or 8 feet can go to her assistance during low water. The regular line steamer between Charleston and this place, though drawing but 6.5 feet, is frequently, during rough weather, compelled to await rising water before attempting to cross. The commerce of Georgetown Harbor is steadily increasing, and would do so much more surely and rapidly could better and safer outlet be established. The manager of the Clyde line of steamers, I am informed, has refused to run his boats between this point and Northern cities on account of the bar, and a syndicate of Boston gentlemen were compelled to relinquish a scheme they had inaugurated for the construction of a railroad from some point west to Georgetown because of the same objection—want of proper and safe navigation for a line of steam-vessels to run in connection therewith. That Georgetown, Conway, Cheraw, Camden, and Columbia, all thriving towns, need water transportation is unquestionable, since they are now left entirely to the mercy of railroad monopolies without an opportunity of exciting that competition, which is the life of trade.

The following commercial statistics for Winyaw Bay Bar have been carefully collected by the undersigned from the most reliable sources for the year ending June 30, 1884:

OUTWARD FREIGHT.

Cotton	bales..	23,100
Clean rice	tierces of 600 pounds..	14,960
Rough rice	bushels..	220,000
Rice flour		20,000
Spirits turpentine	casks..	35,000
Rosin	barrels..	200,000
Tar	do....	3,500
Lumber	feet...	15,000,000
Shingles		3,500,000
Fish	pounds..	50,000
Game	do....	15,000
Wool	do....	40,000
Hides	do....	43,000

INWARD FREIGHT.

Two hundred thousand tons (estimated) general merchandise, such as hay, salt, lime, fertilizers, dry goods, groceries, &c. Of the lumber, 2,383,331 feet, together with 542,200 shingles, were shipped direct to South America and the West Indies. The balance of freight went to home ports.

The commerce is carried on yearly by about 295 sail of sea-going vessels, averaging about 500 tons each, and a number of smaller trading schooners, of which no account could be obtained. There are also about 260 trips of steamers yearly between Georgetown and Charleston, averaging about 300 tons each.

In conclusion, permit me to say that I am greatly indebted to Mr. H. F. Price, first assistant surveyor, for the faithful, thorough, and energetic performance of his duties.

Very respectfully, your obedient servant,

REID WHITFORD,
Assistant Engineer.

Capt. W. H. BIXBY,
Corps of Engineers.

NOTE OF ASSISTANT ENGINEER WHITFORD, APPENDED TO HIS REPORT.

For reasons stated in the report, I am of the opinion that Bottle Channel can be more easily, cheaply, and permanently improved than any other outlet. I may be wrong, but I think so. The depth desired by the improvement is 13 to 15 feet at mean low water. My idea is that submerged jetties (shown on Sheet 11) would likely accomplish that. I think the width of the bases of the proposed jetties should be sufficient to allow their tops to be raised at some future day when commerce demands more water than 15 feet; their tops at present to be 2 below low water, and the width between outer ends contracted to 1,800 feet, as shown on Sheet D. I should think that heavier stone should be used as they are extended to sea.

I would recommend the construction of Jetty A from North Island first. Possibly after this one is built its action will be so satisfactory that the second one, or B, from South Island, will not be needed.

The following I believe to be approximately an estimate of the probable cost of constructing the jetties, one from North Island to D and the other from South Island to I.

Jetty A:	
I to D = 41,666 square yards mats, at $1	$41,666
I to D = 64,097 cubic yards of stone, at $4	256,388
Total	298,054
Jetty B:	
2 to G = 36,888 square yards mats, at $1	36,888
2 to G = 57,638 cubic yards stone, at $4	230,552
G to I = 66,666 square yards mats, at $1	66,666
G to I = 79,444 cubic yards stone, at $4	317,776
Total	651,882
Total of Jetty A	298,054
Total of A and B	949,936

This estimate is subject to change as more accurate information may be obtained.

Yours, very truly,

REID WHITFORD.

APPENDIX N.

IMPROVEMENT OF RIVERS AND HARBORS ON THE COAST OF SOUTH CAROLINA AND GEORGIA, AND PART OF THE ATLANTIC COAST OF FLORIDA.

REPORT OF COLONEL Q. A. GILLMORE, CORPS OF ENGINEERS, BVT. MAJ. GEN., U. S. A., OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1885, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

1. Charleston Harbor, South Carolina.
2. Wappoo Cut, South Carolina.
3. Ashley River, South Carolina.
4. Edisto River, South Carolina.
5. Salkiehatchie River, South Carolina.
6. Savannah Harbor and River, Georgia.
7. Savannah River, Georgia.
8. Savannah River above Augusta, Ga.
9. Saint Augustine Creek (Thunderbolt River), Georgia.
10. Romerly Marsh, Georgia.
11. Altamaha River, Georgia.
12. Brunswick Harbor, Georgia.
13. Entrance to Cumberland Sound, Georgia and Florida.
14. Inside passage between Fernandina and Saint John's River, Florida.

EXAMINATIONS AND SURVEYS.

15. Altamaha River, Georgia, from Darien to its mouth.
16. Darien Harbor, Georgia.

UNITED STATES ENGINEER OFFICE,
New York, July 31, 1885.

GENERAL: I have the honor to transmit herewith my annual reports upon the works of river and harbor improvement under my charge for the fiscal year ending June 30, 1885.

Very respectfully, your obedient servant,

Q. A. GILLMORE,
Colonel of Engineers,
Bvt. Maj. Gen., U. S. A.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

N 1.

IMPROVEMENT OF THE HARBOR AT CHARLESTON (INCLUDING SULLIVAN'S ISLAND), SOUTH CAROLINA.

During the fiscal year ending June 30, 1885, operations for improving the entrance into Charleston Harbor, South Carolina, were carried on in conformity to the plan submitted in my communication to the Chief of Engineers, dated March 9, 1878, and printed as Appendix H of the Annual Report of the Chief of Engineers, 1878.

By this project it is designed to establish and maintain by means of two jetties a low-water channel of not less than 21 feet depth across the bar, upon which the greatest available depth has heretofore been only 11½ feet.

The estimated cost of the project was $1,800,000 to $3,000,000, depending on the length and height of the works.

Previous to the spring of 1878 there had been expended by the General Government in the improvement of the ship-channels in Charleston Harbor, subsequent to the close of the civil war (from 1871 to 1878), the sum of $93,700 in taking up the wrecks of fourteen iron-clad and wooden vessels sunk during the war, and in removing a portion of the Bowman Jetty projecting into Beach Channel.

RECAPITULATION OF OPERATIONS PREVIOUS TO JUNE, 1884.

North jetty.—This work was commenced in December, 1878. On June 30, 1884, the seaward end of the bottom course of the jetty had reached a point 14,327 feet from the starting point on Sullivan's Island, measured along the axis of the work. No work has been done upon this jetty since November, 1881.

The width of this bottom course varied from 43 feet at the shore to 118 feet at the sea end, and in height from 2½ to 4 feet. A second course of mattresses, varying from 66 feet to 81 feet in width, was laid over the bottom course for a length of 1,648 feet from a point about 7,600 feet from Sullivan's Island seaward, the height of this portion of the jetty being thereby increased to 5½ or 6 feet. The gap formerly left on Drunken Dick Shoal was closed by a foundation course of 1,663 feet in length, 64 feet in width, and 3¾ to 4 feet in height. South of that shoal the jetty was raised by distributing riprap stone over it. In some places the height thus attained was from 13 to 14 feet from the bottom.

Up to June 30, 1884, the aggregate amount of riprap stone placed upon the north jetty was 93,902 cubic yards.

The mattress work, of an average thickness of 18 inches, composed of logs and brush, amounted to 144,079 square yards.

South jetty.—This work was commenced in April, 1880. On June 30, 1884, the seaward end of the bottom course had reached a point 13,596 feet from the original starting point on the shore of Morris Island, or 14,109 feet from the high-water mark of that date, and rested in the shoal waters of Swash Reef, about seven-eighths of a mile from the outer 18-foot curve of the bar. The jetty crosses the existing main ship-channel, which runs about parallel to the shore of Morris Island, with a maximum depth of nearly 40 feet at mean low-water; further east the jetty also crosses a deep pocket, with low-water depths of from 18 to 25 feet.

From its starting point on Morris Island the south jetty is laid upon a straight course bearing south 87 degrees east for a length of about

8,660 feet. The direction was then changed, and the axis of the work was laid on chords of about 400 feet length each, corresponding to a circular arc of about 1⅞ miles radius, it being designed to continue this curved line of axis until it should reach a point not over 2,900 feet from the straight seaward portion of the north jetty already laid, whence a straight course was again to be followed to its seaward terminus, parallel to the north jetty. This point was reached in September, 1883, when further operations on the bottom course were suspended for the balance of the fiscal year.

Beyond a point about 7,500 feet from shore a system of spur jetties was adopted as a protection against the scouring effects of lateral and transverse currents, which began to be developed in this vicinity.

The mattresses of the bottom course were here generally 108 feet in width; but from the point just indicated for a length of about 2,600 feet seaward, mattresses of 130 feet width and 50 feet length were introduced at intervals, which projected from 6 to 15 feet on either side, the projecting parts being expected to act as short spurs.

From October, 1882, a modification in the disposition of the foundation course of these spurs was adopted and maintained to the end of June, 1883, in which time the main line of the bottom course of the jetty was extended nearly 2,658 feet seaward.

While continuing laying mattresses of 108 feet width on this latter course the foundation mattresses of spurs were sunk about 200 feet apart, center to center, on both sides of the jetty and opposite to each other, each of these mattresses measuring 50 by 100 feet. Each mattress lapped a few feet on the central foundation course, and therefore projected by nearly its whole length of 100 feet north or south beyond the edge of the central course.

For a length of about 8,500 feet of the jetty from the shore end the successive mattresses of the bottom course were laid in juxtaposition, or with laps of a few feet, but spaces between two adjoining mats could occasionally not be avoided. Further out it was deemed expedient to allow each mat to lap from 10 to 20 feet on the mat previously laid, thus effectually preventing spaces and loss of stone and gaining height.

The high-water line on the sea-shore of Morris Island having considerably receded for several years past, the foundation course of the south jetty was extended 513 feet landward from the original starting point, using log mattresses of 40 feet width, covered with 20 inches of stone.

A second course of mattresses of 40 feet width, loaded with 24 inches of stone, was laid from the original shore end for a distance of 446 feet outward.

The foundation course, where it crosses the deep portion of the existing main ship channel, was overlaid with a second course of mattresses from 40 to 50 feet in width, and of a continuous length of 1,554 feet, beginning at a point about 4, 800 feet from the shore end. This course was loaded with from 12 to 16 inches of stone.

Along the south edge of the foundation course, upon which the second course was placed, additional foundation mattresses were sunk for a length of about 1,570 feet, beginning and ending opposite the two terminal points of the second course. The mats varied from 60 to 100 feet in width. They lap a few feet on those of the main line. By laying this additional apron the width of the bottom course, which here originally varied between 60 and 112 feet, was increased to from 135 to 205 feet. These mats carry from 12 to 18 inches of stone.

A second course of mats of from 44 to 50 feet width, with 18 inches of stone, was placed from a point 7,047 feet from the shore end to a point

9,019 feet out; total length, 1,972 feet. The widths of the bottom course vary here between 100 and 130 feet. This portion of the jetty crosses the deep pocket located to the east of the main ship-channel. The original low-water depths on the line of crossing ranged from 16 to 25 feet.

Material expended.—From the beginning of operations to June 30, 1884, there were employed in constructing both jetties 355,429 square yards of log-and-brush mattresses, averaging 18 inches in thickness and 185,118 cubic yards of riprap stone, to wit:

Where placed.	Mattresses.	Stone.
	Square yards.	*Cubic yards.*
In north jetty	144,077	93,902
In south jetty	211,352	91,216
Total	355,429	185,118

Survey.—A survey of the outer harbor and bar was completed. It extended from Fort Johnson and Moultrieville to the outer 18-foot low-water curve of the bar, and included the shores of Sullivan's Island and Morris Island.

Sullivan's Island.—Some work has been done during the last few years with a view of protecting the sea-shore of the island.

In December, 1880, a spur-dike (A), consisting of log rafts, covered with riprap stone, 324 feet long, was built on the beach 3,050 feet east of Fort Moultrie, and 2,300 feet west of the shore end of the north jetty, under a special appropriation. A similar work (B), 288 feet in length, 1,750 feet east of the fort, was constructed in September, 1881, with funds from the regular appropriation for Charleston Harbor. About 183 cubic yards of broken stone was distributed over some bare portions of the first named spur-dike during the fiscal year ending June 30, 1884

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1885.

On July 1, 1884, the amount available was $231.75. By act of Congress approved July 5, 1884, the sum of $250,000 was appropriated "for continuing the improvement of the harbor at Charleston, S. C., including Sullivan's Island," with the proviso that $5,000 of the sum named may be used in front of Mount Pleasant.

The operations consisted substantially in extending the bottom course of the south jetty, in placing a second course of mattresses with riprap stone over a considerable portion of the bottom course previously laid and upon that laid during the fiscal year, in dredging upon the bar between the jetties, in local surveys of portions of the sea-bar and of Hog Island Channel, and in building two spur-dikes for the protection of a part of the shore-line of Mount Pleasant in the inner harbor. No work was done on the main north jetty.

South jetty.—Operations at the main south jetty were carried on under a contract entered into September 1, 1884, with Mr. A. A. Howlett, who had been the lowest bidder in response to a call for proposals dated July 26, 1884. By the terms of this contract the price paid for log-and-brush mattresses put in the work is 67 cents per square yard, and for riprap stone put in the work $3.41 per cubic yard, a cubic yard of stone being required to weigh 2,800 pounds. The mattresses were constructed substantially in the manner required under Mr. Howlett's previous contract of September 30, 1882.

Work on this jetty was resumed September 19, 1884. The bottom course of the jetty was further extended seaward for a length of 2,288 feet, the axis of the extension following a straight course tangential to the curve along which the foundation had previously been laid. On this new range the jetty runs parallel to the straight seaward portion of the north jetty and 2,900 feet from it. On June 30, 1885, the seaward end of the bottom course had reached a point beyond the crest of the bar at a distance of 16,397 feet from the shore end, measured along the axis of the work, and about 2,400 feet within the 18-foot curve on the outer slope of the bar. The mattresses used were 108 feet wide and about 18 inches thick; each lapped over the preceding one about 6½ feet on an average. The thickness of riprap stone over the mattresses varied from 12 to 14 inches. The low-water depths in which the mattresses were sunk vary from 6 to 12 feet. The last shoal on the crest of the bar is now passed; the seaward end rests at present in a low-water depth of 8 feet.

A second course of log-and-brush mattresses was placed upon the foundation course, commencing at a point about 9,600 feet from the present shore end, and carried continuously seaward for a length of 6,614 feet, or nearly to the outer end of the bottom course laid during the season. The mattresses of this course ranged from 50 to 55 feet in width. They were covered with from 12 to 17 inches of stone. Much difficulty was experienced in sinking mattresses and depositing stone while working in the vicinity of the crest of the bar, the sea waves breaking with great force on these shoal waters for a large part of the time, to the greater or less danger of both men and plant. The depths over the bottom course varied here from 3 to 9 feet at low tide. At the shoalest places the stone covering of the second course is nearly up to the low-water level.

At the end of the fiscal year the foundation course of the main south jetty was 15,884 feet from the original shore end and 16,397 feet from its present shore end at the high-water mark of 1884, measured along the axis of the work.

The second course does not yet form a continuous work, but is in four detached sections of an aggregate length of 10,536 feet. The section nearest Morris Island commences at the original shore end. The present outer end of the most seaward section is about 15,750 feet from the same point.

The log and-brush mattresses laid during the year averaged 18 inches in thickness, and amounted to 69,398 square yards, upon which riprap stone, aggregating 25,183 cubic yards, was deposited.

From the beginning of operations to June 30, 1885, there have been used in the construction of the south jetty 280,750 square yards of mattresses and 116,399 cubic yards of riprap stone.

LENGTH OF BOTTOM COURSES OF BOTH JETTIES ON JUNE 30, 1885.

	Feet.
North jetty from Sullivan's Island	14,327
South jetty from original starting point, Morris Island (corrected measurement)	15,884
South jetty from high-water mark of June 30, 1884	16,397

Dredging on the bar.—The work on the jetties having progressed far enough to render it advisable to aid their action by dredging, proposals were invited, under date of January 5, 1885, for removing from 50,000 to 200,000 cubic yards of material on a line between the two jetties reaching from the inner slope to the outer slope of the bar. The speci-

fications also permitted proposals to be offered for producing a deeper channel by the use of appliances for stirring up the material with a view to its being carried away by the natural current, with the understanding that the bidder intending to use such a method should name a price for creating a continuous channel not less than 16 feet deep and 200 feet wide at mean low water, extending entirely through the bar from the inner to the outer slope thereof. Four proposals were received, three of which provided for removing the material by the cubic yard, while the fourth contemplated deepening the channel by stirring up the material with powerful water jets. The price asked per cubic yard of ordinary dredging was considered too high, while the fourth offer was coupled with the condition that the United States should advance funds to the contractor before any work was done by him. With the approval of the Department all these bids were, therefore, rejected.

Subsequently Mr. Hugh H. Penny, who had been the lowest of the three bidders for dredging by the cubic yard, made a proposal to reduce his first bid of 34 cents per cubic yard to 30 cents. This offer was accepted, and a contract entered into with Mr. Penny February 9, 1885.

For the axis of the channel to be dredged a line was selected beginning about 875 feet north of a point of the south jetty nearly 11,000 feet from its shore end and running south 69 degrees east. The axis is not quite parallel to the straight seaward portions of the jetty; it is nearer to the south jetty at the inner end and nearer to the north jetty at the outer end. The line was given this location in order to take advantage of the pocket of deep water north of the south jetty, on the inner slope of the bar, which ends in Swash Channel near the bell buoy. The line selected is practically coincident with the line of greatest scour between the jetties. It is intended at present to cut a channel of a uniform low-water depth of 15 or 16 feet, of such width as the funds set apart for dredging will cover. The length of such a cut, from the inner to the outer 16-foot curve, will be about 6,800 feet. Just before the dredging was begun soundings were taken which showed an average low-water depth along the axis of the contemplated cut of 12.3 feet; the least depth found was 7.7 feet.

The propeller upon which the dredging plant was placed measures about 110 feet in length and 29 feet beam. Fully loaded it draws 9 feet, or 8 feet on an even keel with a load of 350 tons. The engines are 20-inch cylinder and 20 inches stroke, with surface condenser. The boiler measures 7½ feet by 14 feet; steam pressure, 70 pounds allowed. This boat carries a 12-inch centrifugal pump, with a 9-inch flexible suction-pipe on either side, furnished at the lower end with a drag which rests and moves along on the bottom when the machine is at work. The discharge-pipe on deck is of 12 inches diameter.

There is a clear deck of 72 feet from the pilot-house to the stern of the boat; 52 feet of this length is occupied by the bins, which extend across the whole width of the deck. This space is divided longitudinally by a central partition and transversely by two partitions, thus forming six compartments or bins, three on either side. They cover an aggregate area of 52 feet by 28 feet. The height of the partition walls is about 4 feet.

Upon the central partition rests the square wooden trough which conveys to the bins the water and sand delivered by the discharge-pipe. It is claimed by the manufacturer of the pump that when worked to its full capacity it will deliver 7,000 gallons of water per minute, equal to 933 cubic feet or 34½ cubic yards. The trough is furnished with gates, by which the flow may be admitted to any compartment. The bins are

emptied through scuppers on either side, opened or closed at pleasure by gates worked with chains suspended from a shaft resting upon bearings on the gunwales; the shafts are provided with pawl and ratchet movements and sockets for inserting handspikes for maneuvering the scupper gates.

To insure, as far as practicable, a straight direction of the cut a marginal line on either side of the axis, and about 75 feet from it, is marked with poles, mounted on frames loaded with stone, placed at convenient distances from each other.

The contractor was to begin work during the early part of March, 1885, but owing to unavoidable delay in completing the pumping machinery, detention of the steamer en route from New York to Charleston, and damages to the propelling machinery on the trip, an extension of time to May 20, 1885, was granted. From that date to the end of the fiscal year 8,929 cubic yards of material, consisting of sand and small light shells, were removed.

Mount Pleasant spur-dikes.—The sum of $5,000 having been set apart from the existing appropriation for Charleston Harbor for the purpose of constructing works for protecting the shore-line of Mount Pleasant, it was proposed to expend this amount in building short spur-dikes on the reach southeast of the ferry-boat wharf at that place. Under authority of the Department an agreement was entered into with Mr. A. A. Howlett to build the dikes, consisting of a course of log mattresses of 15 feet width, with logs from 9 to 12 inches diameter, held together by two binders on top, 2 feet from the ends of the logs, and overlaid between the binders with riprap stone piled up to a heighth of 4 feet in the center. The price paid was $4.95 per linear foot of dike.

Two of these spurs were built at right angles to the shore-line described; one of 477 feet length about 1,750 feet southeast of the ferry-boat wharf, and the other of 475 feet length about 950 feet lower down They were completed in October, 1884.

Surveys.—Besides numerous local surveys incidental to the work, including an examination of Hog Island Channel, a resurvey was made of the area between the seaward portions of the jetties and on the outer slope of the bar, extending to the outer 5-fathom low-water curve.

CONDITION AND EFFECTS OF THE WORKS AND CHANGES IN THE HARBOR AND ON THE BAR.

The north and south jetties.—No special examination by diver or otherwise of the two main jetties extending across the bar has been made during the past fiscal year. From the facts communicated in my last annual report that sand was freely accumulating upon portions of the works, that the consolidation of the stone work, aided by the growth of barnacles and shell-fish, was progressing, and that the accretion of sand and mud was taking place on the seaward sides of the jetties, it is inferred that no material changes in their condition have occurred, the scour along the edges of the jetties having apparently ceased or greatly diminished. No spurs were used in extending the south jetty during the year. On the line of the south jetty the high-water section is at present reduced by nearly 25 per cent., about equal to reduction of the corresponding area of the north jetty.

Swash Channel and the bar.—(The Swash Channel is the one between the jetties.) The area of Jim Evans Shoal, about seven-eighths of a mile inside the ends of the jetties, has somewhat diminished above the 9-foot low-water curve; the portion near the north jetty continues to

move seaward, and its southerly portion, which had shown a tendency to approach the south jetty, has receded from it in a noteworthy degree. The average depth over the shoal has increased, while directly to the seaward of it the channel has slightly shoaled as the result of the outward movement of sand.

The area comprised between the inner and outer 9 foot curves of Swash Reef has been much reduced. An increase of depth in the jetty channel is noted just above the reef.

The 18-foot curve of the "Inner Pocket," on the inner slope of the bar, has pushed seaward about 800 feet during the year; its lower end is located about 500 feet north of the south jetty. The 18-foot curve of the outer slope of the bar, between the prolongations of the jetties, has not sensibly changed its position. These two curves are at present about 6,400 feet apart, which is less by 800 feet than their distance apart one year ago. The corresponding 15-foot curves are now about 600 feet nearer together than they were a year ago; they are about seven-tenths of a mile apart at the nearest points.

From the fact that the curves on the outer slope of the bar have remained about stationary, or, to be more exact, have slightly moved shoreward, thereby indicating a slight scour between the jetties, it may be inferred that the material from the shoals between the jetties was not brought to permanent rest directly in advance of the jetty channel, but was carried away by the littoral currents and deposited elsewhere, probably upon the outer slope of the bar to the southward.

Much of the favorable change that has lately taken place toward deepening the water-way between the jetties has doubtless been produced by raising a considerable portion of the south jetty by means of a second course of mattresses and riprap stone. This work is still in progress. The sea end of the north jetty will also be carried a little higher under the existing contract.

On the whole the results are highly satisfactory as indicating the development of a scouring velocity between the jetties, although neither jetty has reached by several feet the least height contemplated in the approved project. The sea end of the north jetty, that portion located upon the bar, still lacks 11 feet, while the corresponding portion of the south jetty lacks $9\frac{1}{3}$ feet of the height upon which the plan of improvement and estimates were based. The shore ends are also lower than that assumed height, so much so that the north jetty has to be raised an average of about $2\frac{1}{2}$ feet for a length of 4,000 feet, and the south jetty an average of 7 feet on a length of 7,000 feet. It has never been claimed, however, that it might not be necessary in the interests of a deeper navigation to give the jetties a greater height, and the original estimates of cost from $1,800,000 to $3,000,000 recognized this contingency. But what is known as high jetties, that is to say jetties rising above the high-water level, are believed to be not only unnecessary but unsuitable for this locality.

Although the concentration of water upon the bar secured by the jetties up to the present time is small in comparison with what is intended and with what the plan requires, both works being as yet little more than foundation courses, there is reason to believe that even in their present condition they are able to maintain a deeper channel than that which now exists between them. If the cut which the dredge is now making to aid the scouring force of the slightly accelerated current shows any tendency to fill up, the dredging will be suspended and not again resumed until the jetties are built higher.

I wish to reaffirm my confidence in the ability of these works, when completed, to maintain a deep navigable channel across the bar.

Adverse criticisms on the efficacy of submerged jetties have no application to the Charleston works. The latter are strictly tentative in character, and their distance apart was planned with the special object of reserving entire freedom of choice with respect to their ultimate height.

Their crests can, of course, be carried up to the height necessary to maintain the desired channel depth between them, and should not go an inch higher. Where they cross the bar they are half a mile apart, equal to about one-half the width of the throat of the harbor between Forts Sumter and Moultrie, where the high-water depths are 70 to 75 feet.

Omitting engineering technicalities, two significant questions may be stated, as follows:

(1) If the volume of flow between Sumter and Moultrie maintains a depth of 70 feet where the width is nearly 1 mile, will all that volume be required to flow between the jetties, where the width is only half a mile, in order to maintain a high-water depth of 28 to 30 feet? The answer suggests itself, viz, not all the water flowing past Fort Sumter will be needed between the jetties. The plan, therefore, allows part of it to pass over their tops, thereby lessening the cost of the works more than one-half with another positive advantage mentioned below.

(2) If the flow between Sumter and Moultrie maintains a high-water depth of 70 feet, where the width is nearly 1 mile, what depth would the same volume of flow maintain across the bar if it all passed between the jetties where the width is only half a mile? The answer is again evident that, under these conditions, the depths scoured out would be excessive, possibly endangering the stability of the works themselves, and transporting a large body of sand to the seaward slope of the bar beyond the end of the jetties. This would introduce serious complications in the way of new shoals and a new outer bar. It has been one of the leading objects of the plan of improvement to avoid this contingency by placing the works comparatively near to each other, thereby diminishing the quantity of sand to be scoured out in order to get the requisite channel depth.

Indeed it goes without saying that the Charleston jetties should not excavate a channel between them of unnecessary depth and width with the certain result that the excess of material removed will be deposited outside where the natural depths are very moderate and the slope of the bottom exceptionally flat, and where we must depend for its removal upon the intermittent and irregular littoral current produced by winds. Where interests of great magnitude are at stake ordinary prudence suggests that there should be a liberal factor of safety. This is provided in the present project by reserving the power to restrict the volume of flow and the amount of scour between the jetties.

The Sullivan's Island Beach has been lowered by erosion in the vicinity of the Bowman Jetty on either side, but more especially just west of it where the beach has been washed down about 4 feet. For several hundred feet on either side of spur jetty B, the nearest one to Bowman's Jetty, the beach has been built up from 1.8 to 2.5 feet higher than it was a year ago, and a similar filling up is going on further east as far as the shore-end of the north jetty.

The Morris Island Beach, in the vicinity of the shore end of the south jetty, shows that some very slight washing has occurred during last year, but not of a nature to call for special preventive measures.

Hog Island Channel in the Inner Harbor has, according to authentic information, been getting wider near its inner end for more than sixty years. In 1823 its width was about 1,400 feet, at present it is about 2,000 feet. In my last Annual Report it was stated that this progressive widening of Hog Island Channel will cause a larger volume of water to be voided in the direction from Cooper River and the other northerly branches of the harbor, to the detriment of the deep-water area between Shutes Folly Island and the line of wharves on the east side of the city of Charleston. The encroachment on the shore of Mount Pleasant, on the north side of the channel, is probably to a considerable extent due to this increased flow of water as well as the increased depths opposite the mouth of Shem Creek, at the most northerly part of the bight formed by Hog Island Channel where an examination made in February, 1885, has shown that a low-water depth of 13.6 feet could be found in a continuous and nearly straight course, where formerly less than 12 feet existed.

Some work will soon have to be done to stop the enlargement of Hog Island Channel. A sill-dam across the entrance and some spur-jetties will perhaps be required, but no appropriation for these objects is recommended at present. Not until the main north and south jetties shall have produced a decided improvement on the bar can the appropriations for Charleston Harbor be properly diverted to the less important works of the inner harbor.

Mount Pleasant.—This place is situated in the bight formed by the Hog Island Channel, 3 miles from the city of Charleston. The shore line northwest and southeast of the ferry-boat wharf at Mount Pleasant, or from Shem Creek southeast, a distance of about 7,000 feet to a point opposite the westerly end of Sullivan's Island, has been washing away more or less for several years past, and aid from Government has repeatedly been asked by citizens of Mount Pleasant to arrest further encroachments. The two spur-dikes built during the past fiscal year form only part of a plan devised to protect the whole line. But it seems quite clear that no funds appropriated for improving Charleston Harbor can properly be applied to the protection of the Mount Pleasant front, which is essentially a matter of private concern, having no connection whatever with the improvement of the harbor proper. The works that will ultimately be required at the upper entrance of Hog Island Channel in order to arrest the progressive deterioration of the channel leading past the city wharves, will most probably prevent further inroads upon the Mount Pleasant shore by diminishing the flow of water through the channel.

OPERATIONS CONTEMPLATED DURING THE FISCAL YEAR ENDING JUNE 30, 1886.

With the balance of $97,267.92 available July 1, 1885, the work of raising portions of both jetties to a greater height, and of dredging between the seaward portions of the jetties, will be continued as far as the funds will permit.

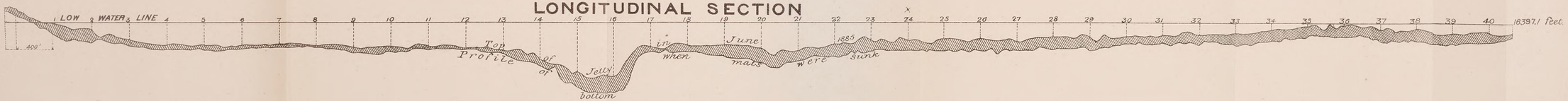
Attention has been called in former annual reports to the necessity of making liberal appropriations for completing this great improvement. The foundations of both jetties have now been laid nearly to the full length contemplated, and a second course of mattresses and stone already covers considerable portions of them. The natural scour between the jetties has for some time past been increased by these works, and the shoals obstructing the proposed line of channel are being gradually lowered, reduced in area, or pushed seaward into deeper water. These movements on the bar are now aided in some measure by dredging.

IMPROVING HARBOR
AT
CHARLESTON. S.C.

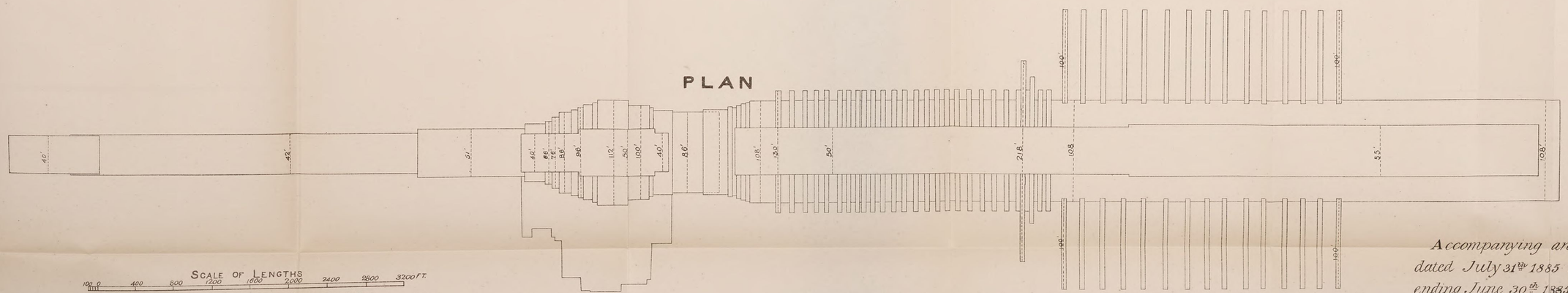
SHEET 1

showing section of the South Jetty and a plan of the mattress at various points as built to June 30, 1885.

LONGITUDINAL SECTION



PLAN



SCALE OF LENGTHS
100 0 400 800 1200 1600 2000 2400 2800 3200 FT.

SCALE OF HEIGHTS
10 0 10 20 30 40 50 FT.

SCALE OF WIDTHS
40 0 40 80 120 FT.

Accompanying annual report dated July 31st 1885 for fiscal year ending June 30th 1885.

J. G. Gillmore
Col. Engrs. Bvt Maj Genl USA

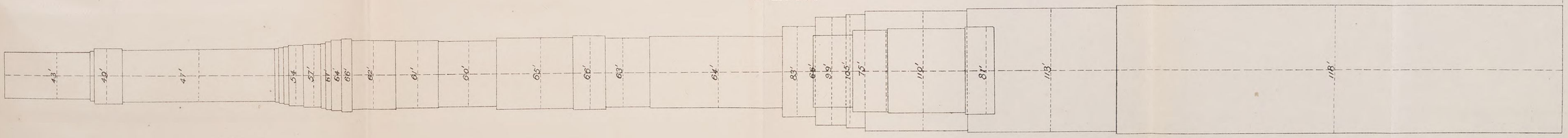
H Ext pt2 v2 491

IMPROVING HARBOR
AT
CHARLESTON, S.C.
SHEET 2.

showing section of the North Jetty and a plan of the mattress at various points as built to June 30, 1885.

LONGITUDINAL SECTION

PLAN



SCALE OF LENGTHS
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SCALE OF HEIGHTS.
10 0 10 20 30 40 50 FEET.

SCALE OF WIDTHS.
40 0 40 80 120 FEET.

Accompanying annual report dated July 31st 1885
for fiscal year ending June 30th 1885.

D. A. Gillmore
Lt. Col. Engrs. Bvt. Maj. Genl. U.S.A.

H Ext pl2 v2 49 1

Accompanying annual report dated July 31, 1885
for the fiscal year ending June 30, 1885.

2d A. Gillmore
Col. Engrs Bvt Maj Gen USA

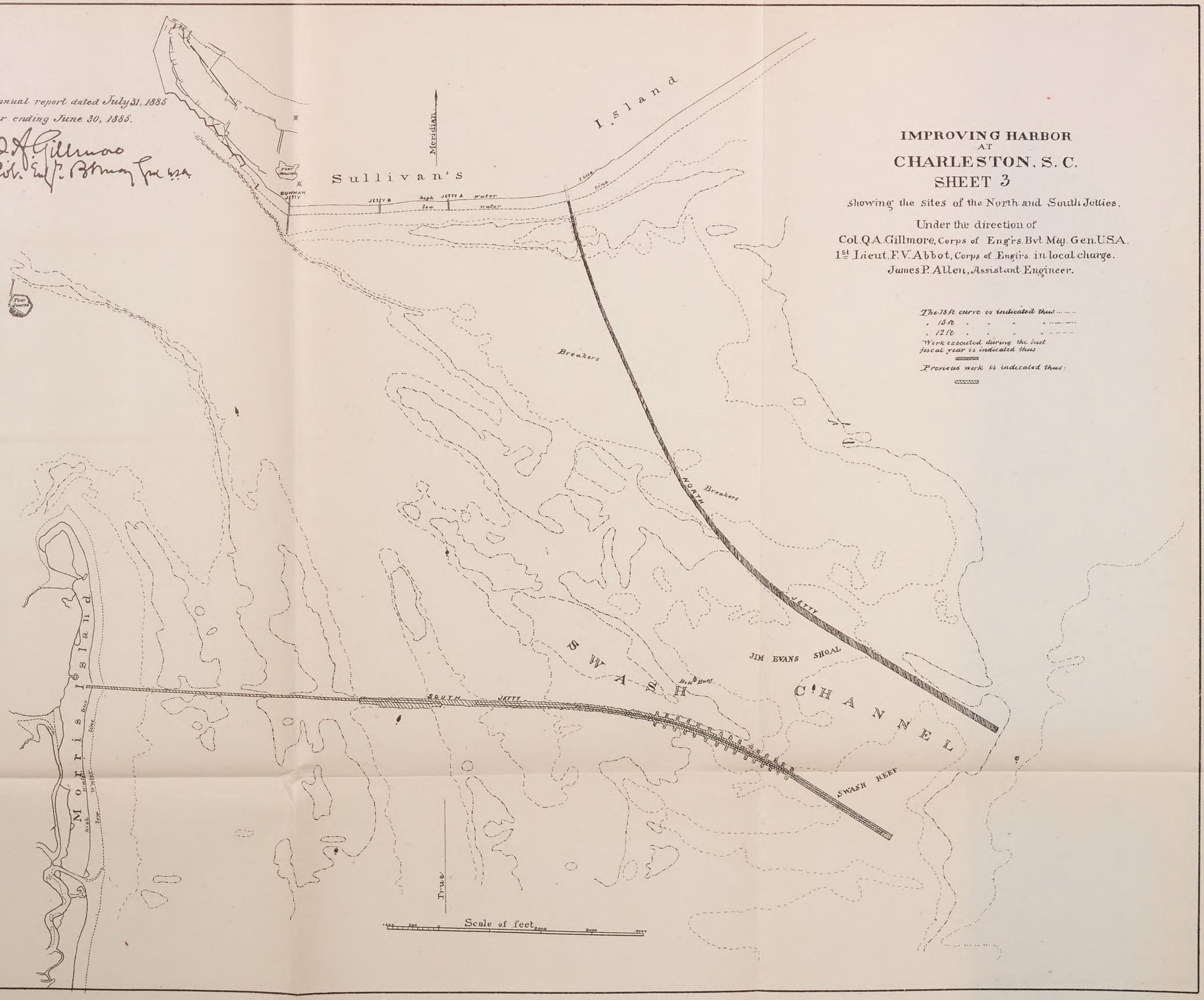
IMPROVING HARBOR AT CHARLESTON, S. C.

SHEET 3

Showing the Sites of the North and South Jetties.

Under the direction of
Col. Q.A. Gillmore, Corps of Engrs. Bvt Maj. Gen. U.S.A.
1st Lieut. F.V. Abbot, Corps of Engrs. in local charge.
James P. Allen, Assistant Engineer.

The 18 ft curve is indicated thus .....
" 15 ft " " " " .....
" 12 ft " " " " .....
Work executed during the last fiscal year is indicated thus
Previous work is indicated thus



H Ex1 pt2 v2 49 1

In last year's report I took occasion to speak of the deterioration of Pumpkin Hill Channel, the present channel of entrance across the bar, which is slowly but unavoidably going on in consequence of the increasing outflow between the jetties. It is of the utmost importance that the period of bad navigation, during which Pumpkin Hill Channel will continue to shoal while the new jetty channel is not yet fully developed, should be made as brief as possible.

It was originally designed to expend about $100,000 for dredging between the jetties. The funds set apart from the existing appropriation for this kind of work cannot be expected to produce very decisive results, even in conjunction with the existing jetties, although it will doubtless have a tendency to secure a better direction as well as a greater concentration of ebb-currents through the new channel. But the improvement that may be effected by dredging will be partially and perhaps wholly lost by the unavoidable suspension of operations which must necessarily take place in a few weeks, and may be expected to last for a year or more.

This work is located in the collection district of Charleston, S. C., at the port of entry. Amount of duties collected in the calender year 1884, $36,624.76.

Since the existing plan of improvement was adopted the following appropriations have been made:

By act of Congress approved June 18, 1878	$200,000
By act of Congress approved March 3, 1879	200,000
By act of Congress approved June 14, 1880	170,000
By act of Congress approved March 3, 1881	175,000
By act of Congress passed August 2, 1882	300,000
By act of Congress approved July 5, 1884	250,000
Total	1,295,000

Of this amount there had been expended from the beginning of operations to June 30, 1885, including outstanding liabilities, the sum of $1,197,732.08, of which the sum of $5,000 was diverted to works for the protection of the Mount Pleasant front.

Balance yet to be appropriated on the original maximum estimate, $1,712,500.

The following drawings and papers accompany this report:

Sheet 1. Longitudinal section and diagram of widths of south jetty at the close of the fiscal year.

Sheet 2. Longitudinal section and diagram of widths of north jetty at the close of the fiscal year.

Sheet 3. Skeleton sketch showing sites of both jetties.

Report of First Lieut. Frederic V. Abbot, Corps of Engineers.

Table of commercial statistics furnished by the collector of the port.

Money statement.

July 1, 1884, amount available		$231 75
Amount appropriated by act approved July 5, 1884		250,000 00
		250,231 75
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$122,233 65	
July 1, 1885, outstanding liabilities	30,730 18	
		152,963 83
July 1, 1885, amount available		97,267 92
Amount (estimated) required for completion of existing project		1,712,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		750,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for construction of jetties in Charleston Harbor, South Carolina opened August 16, 1884.

No.	Names of bidders.	Inside of crest of bar.		Outside of crest of bar.		Aggregate cost of the work.	Date of commencing work and monthly progress.
		Mattress.	Stone.	Mattress.	Stone.		
		Square yard.	*Cubic yard.*	*Square yard.*	*Cubic yard.*		
1	P. Sanford Ross	$0 66	$3 49	$0 66	$3 49	$232, 950	As required by specification.
2	Rittenhouse Moore....	1 35	3 40	1 35	3 40	308, 250	Do.
3	John F. Gaynor	69	3 59	69	3 59	239. 900	Do.
4	William H. Browne .	75	3 65	99	4 24	286, 608	Do.
5	Alfred Ames Howlett	67	3 41	67	3 41	230, 500	Do.

Contract awarded to Alfred Ames Howlett at the prices stated.

Abstract of proposals for dredging between the jetties im Charleston Harbor, South Carolina, opened January 26, 1885.

No.	Names of bidders.	Per cubic yard.
1	Morris & Cumings Dredging Company.....	$0 68
2	Hugh H. Penny	34
3	P. Sanford Ross	65
4	Roy Stone	(*)

* As a contribution to the expense of a test continuing not less than six weeks the sum of $15,000 to be paid upon the arrival of the steamers ready for work at Charleston; $35,000 upon completion of channel; $12,500 upon completion of each additional cut of 50 feet width, except the final cut on each side, which shall be $15,000 in consideration of trimming the slopes, or if cuts are all on one side, an allowance of $3,000 to be made for trimming slope on other side.

Proposals rejected, the prices being deemed too high.

Abstract of proposal for dredging between the jetties in Charleston Harbor, South Carolina, received February 7, 1885.

No.	Name of bidder.	Price per cubic yard.	Date of commencing work.	Monthly progress.
1	Hugh H. Penny.....	$0 30	Commence on or before March 9, 1885.	Remove 25,000 cubic yards per month.

Contract awarded at the price stated.

REPORT OF LIEUTENANT FRERERIC V. ABBOT, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Charleston, S. C., July 16, 1885.

SIR: I have the honor to submit the following report of operations during the past fiscal year for improving harbor at Charleston, S. C.

Work on the jetties was resumed in September, 1884, under the contract of Alfred Ames Howlett, dated September 1, 1884. It has continued up to the close of the year

and has been confined to the south jetty. The foundation has been extended 2,288 feet with mattresses 108 feet wide, loaded with from 12 to 14 inches of stone. The second course has been extended in all 6,614 feet, about 2,200 feet being with mattresses 50 feet wide, and the balance with mattresses 55 feet wide. Because of special local requirements the loading of stone has varied from 17 inches to 12 inches. Much of the work has been done in very shoal water, over the top of work already laid, and in places where breakers formed whenever there was a stiff breeze. The contractors deserve great credit for the energy they have shown in overcoming these difficulties. On June 30, 1885, the total length of the foundation course of the north jetty was 14,327 feet, that of the south jetty 16,397.

The sea end of the former was 1,100 feet, that of the latter 2,400 feet inside of the outer 18-foot curve, this being measured on the prolongation of the axes of the two jetties respectively.

In May, 1885, dredging was begun between the jetties on a range which is about coincident with the line of the greatest scour produced by the jetties.

An accurate survey of the area between the outer portions of the jetties and on the outer slope of the bar has been made. It extends to the 5-fathom contour. Extreme care has been exercised in making and reducing the soundings, the latter being taken only near slack water, and the reduction by the self-registering gauge on Sumter Wharf being checked by occasional reading of a tide-gauge set up on the jetty about 2 miles from shore. It shows that, since the last published Coast Survey soundings, the outer slope of the bar has as a whole moved on the average 800 to 1,000 feet toward the land.

SULLIVAN'S ISLAND.

The series of changes that occurred prior to June 30, 1884, in the beach of Sullivan's Island are fully stated in the report for Charleston Harbor, made by Capt. Thomas N. Bailey, Corps of Engineers, published in the Report of the Chief of Engineers for 1884. The beach has been watched during the past fiscal year, sections being run at different points from time to time. A marked erosion has occurred at the Bowman Jetty. Just west of this jetty it amounts to 4 feet vertically, to the east it is not so marked, and 250 feet further east there has been but little change during the year. At points 1,100 feet east and 2 200 feet east the beach has risen 2 5 and 1.8 feet respectively. These points are about 600 feet west and 400 feet east of Jetty B. Still further east the beach is filling up to a considerable extent. This is the case at Jetty A and at the shore end of the north jetty.

MORRIS ISLAND.

No survey of the north end of the island has been made this year. Cross-sections of the beach near the shore end of the south jetty show a very slight erosion since the last annual report was made. The inward extension of the south jetty seems to have checked the cutting of the shore although this action is not entirely stopped.

HOG ISLAND CHANNEL.

A survey of Hog Island Channel was made in February, 1885. There is a considerable deepening opposite Shem Creek, the rest of the channel being about as previously reported.

MOUNT PLEASANT SHORE.

Two spurs were built east of the ferry wharf in August, September, and October, 1884, to stop the washing away of the Mount Pleasant shore. They are 850 feet apart at the inner ends, increasing to 1,000 feet at the outer extremities. The west spur is 477.1 feet long; the east is 475.5 feet long. Sand is now accumulating around their shore ends.

PUMPKIN HILL CHANNEL.

No examination has been made of this channel during the last fiscal year.

SOUTH CHANNEL.

No examination has been made of this channel during the last fiscal year.

BEACH CHANNEL.

No examination has been made of this channel during the last fiscal year.

SWASH CHANNEL.

The area of Jim Evans Shoal above the 9-foot curve has diminished slightly, that portion of it near the north jetty having moved outward as in previous years. The rapid advance of this shoal in a direction towards the south jetty has been stopped by the second course work done during the last year. There is a gain in depth over the entire shoal.

The area of Swash Reef above the 9-foot curve has been reduced largely during the last year. The shoal has not moved materially, except at its northeastern end, which has been pushed away from the north jetty to a very marked degree. As a shoal it has receded from the north jetty.

Swash Channel, so named on the accompanying map, has decreased in depth immediately seaward of Jim Evans Shoal. Just above Swash Reef there is an increase in depth, most marked near the south jetty. Between Swash Reef and the north jetty there has been shoaling, while there has been a widening of the channel in this vicinity, when the 9-foot curve is considered.

The 18-foot curve inside the bar has advanced seaward during the year, most markedly in a sort of pocket about 500 feet northeast of the south jetty. The same curve on the outer slope has remained stationary. The two are now 6,400 feet apart at the nearest points. The inner 15-foot curve has pushed seaward 450 feet, and the outer curve has moved shoreward about 100 feet. The two are now 3,700 feet apart at the nearest points. The effects on the inside curves are, I think, largely attributed to the same cause which has stopped the pushing southward of Jim Evans Shoal, that is, the recent second course work on the south jetty.

There has been no conspicuous seaward advance of any of the curves on the outer slope of the bar; the inner curves have all advanced seaward, causing a large reduction of volume in Swash Reef. Jim Evans Shoal has not changed so materially, but the danger of its closing in on the south jetty seems to have been averted, as it has sensibly retired from that jetty, as compared with last year's survey. The pocket along the north jetty has advanced seaward, but shows no great change in depth.

A close study of the above shows that the following very favorable changes have occurred:

(1) The narrowing of the entrance to the channel by the movement of Jim Evans Shoal has been stopped.

(2) Swash Reef has been pushed bodily from the north jetty, and its inner side has been scoured largely, so that it is narrower than before.

(3) The outer curves have not advanced seaward, which would seem to indicate that the material which has been removed has found a resting-place to the south and west of the jetties, where it does no harm. When the new channel has broken through Swash Reef this feature of the sand movement may be changed, but it is a very favorable circumstance that so much of the material has already been disposed of where it will not have to be moved again.

The effect of the jetties seems to have been much intensified by the raising they have received this year, and it does not seem unreasonable to look for still more activity, when they are raised still higher in the future.

The dredge has done what is equivalent to about one month of continuous work. It has produced a deepening of about 1 foot over the crest of the bar between the 13-foot curves. Its continued action under the more favorable circumstances which now attend its working may materially hasten the breaking out of the new channel, but not enough experience has as yet been had in its use to justify any definite statements. The only material so far found has been sand and small light shells.

Mr. James P. Allen, assistant engineer, has rendered most valuable and efficient service during the entire year.

Respectfully submitted.

FREDERIC V. ABBOT,
First Lieutenant of Engineers.

Col. Q. A. GILLMORE,
Corps of Engineers, Bvt. Maj. Gen., U. S. A.

COMMERCIAL STATISTICS.

Arrivals and clearances of vessels, and commerce at Charleston, S. C., from January 1, 1875, *to December* 31, 1884.

ARRIVED.

Year.	Coatwise.			Foreign ports.						Total.		
				American vessels.			Foreign vessels.					
	Vessels.	Tonnage.	Crew.	Vessels.	Tonnage.	Crew.	Vessels.	Tonnage.	Crew.	Vessels.	Tonnage.	Crew.
1875	504	382, 018	11, 949	38	13, 144	326	198	88, 879	2, 404	740	484, 041	14, 379
1876	471	340, 439	10, 113	44	11, 898	335	224	101, 272	2, 768	739	453, 609	13, 216
1877	400	324, 919	9, 885	32	13, 972	308	236	105, 480	2, 851	668	444, 371	13, 044
1878	396	322, 527	9, 623	44	19, 935	455	329	163, 368	3, 967	772	505, 830	14, 045
1879	383	326, 68[illegible]	10, 027	39	12, 505	319	246	121, 503	3, 292	668	460, 689	13, 638
1880	441	388, 026	10, 641	38	12, 412	327	191	110, 771	2, 595	670	511, 209	13, 563
1881	412	399, 732	10, 377	34	9, 430	272	257	121, 077	3, 073	703	530, 239	13, 722
1882	410	384, 690	9, 446	35	4, 807	224	200	105, 647	2, 648	645	495, 144	12, 318
1883	345	277, 538	7, 629	26	3, 002	157	239	113, 768	2, 958	610	394, 308	10, 744
1884	425	304, 382	9, 822	21	3, 910	145	214	134, 076	3, 269	690	442, 368	13, 236

CLEARED.

1875	461	328, 266	10, 830	57	24, 679	555	211	94, 595	2, 527	729	447, 540	13, 912
1876	431	278, 744	9, 095	60	23, 598	546	230	103, 276	2, 812	721	405, 618	12, 453
1877	335	234, 429	7, 719	35	22, 767	423	250	108, 446	2, 910	620	365, 662	11, 052
1878	266	172, 988	5, 801	45	24, 397	479	398	149, 975	3, 591	509	347, 360	14, 045
1879	287	188, 212	6, 268	34	17, 282	292	278	149, 052	3, 643	599	348, 546	10, 203
1880	296	190, 733	6, 348	45	23, 210	481	246	155, 768	3, 375	587	369, 711	10, 204
1881	268	187, 569	5, 942	32	9, 239	255	278	153, 796	3, 464	578	350, 604	9, 661
1882	147	113, 699	3, 690	40	7, 375	273	263	158, 250	3, 584	450	379, 324	7, 547
1883	98	48, 714	2, 018	27	4, 560	181	299	154, 653	3, 815	424	207, 927	6, 014
1884	212	116, 020	4, 555	31	7, 845	217	276	161, 588	3, 727	519	285, 453	8, 499

COMMERCE.

Year.	Value of exports.	Value of imports.	Duties collected.
1875	$19, 655, 966	$680, 343	$80, 656 00
1876	18, 088, 152	455, 562	89, 168 00
1877	16, 917, 492	161, 237	46, 848 00
1878	21, 167, 575	184, 127	36, 990 00
1879	18, 693, 126	127, 981	24, 070 00
1880	24, 939, 259	248, 158	46, 453 98
1881	21, 927, 269	713, 049	99, 066 23
1882	19, 907, 099	459, 970	45, 263 33
1883	20, 144, 365	467, 648	48, 760 69
1884	20, 833, 424	503, 504	36, 624 76

T. B. JOHNSON,
Collector.

N 2.

IMPROVEMENT OF WAPPOO CUT, SOUTH CAROLINA.

The work of improving Wappoo Cut, South Carolina, has been done thus far by means of two appropriations, aggregating $20,000. A third appropriation of $3,000, made in 1884, has not yet been expended.

Wappoo Cut is a narrow, tortuous, tidal stream, separating James Island from the mainland, and connecting Stono and Ashley rivers. An examination of the creek was made under my direction some years ago, the report of which, with project of improvement, forms part of Appendix J 4, Annual Report of the Chief of Engineers for 1881, and is printed as House Ex. Doc. No. 19, Forty-sixth Congress, third session.

The project of improvement contemplates the establishment of a straighter channel of 6 feet depth and 90 feet width at mean low water, and comprises the following details of work:

(1) Dredging on the bar at the entrance into Ashley River;

(2) A solid cut through the marsh at the end of the first easterly reach, 2½ miles from Ashley River;

(3) Dredging in Elliott's Cut, and the reach leading to it, and on the bar at the outlet into Stono River;

(4) Closing by a light bulkhead the three tidal streams that enter this new route from the north;

(5) Building a jetty at the Ashley entrance to guide the flood tide into Wappoo Cut, and

(6) Building a jetty at the Stono entrance to guide the ebb tide into the cut.

The aggregate cost of these works was estimated at $34,000.

The mean rise and fall of tides in Wappoo Cut is about 5 feet.

The delays in providing funds for carrying on the work, and the small amounts appropriated, have rendered it impossible to complete the work at every point. The unfinished cuts are therefore partially filled up from caving banks during the unavoidable and prolonged suspension of operations. A considerable increase in the total ultimate cost of the improvement is therefore unavoidable.

OPERATIONS PREVIOUS TO JULY 1, 1884.

The work consisted chiefly in dredging. Elliott's Cut was improved through its entire length of about 2,000 feet by establishing a low-water depth of 6 feet on an average width of 60 feet. A solid cut 800 feet long was made through the marsh of "Devils Elbow," securing a straight and convenient passage in place of the extremely tortuous route through the bend bearing that name, which from end to end has a total length of about 6,000 feet. The cut had a depth of 6 feet at mean low water and an average width of 80 feet. A channel of the same depth was secured through the shallow bends from Elliott's Cut to the marsh cut. Some dredging was also done on the bar at the entrance from Ashley River to the cut.

The material removed by dredging aggregated 101,956 cubic yards.

A bulkhead was built across "Pompey's Cut," a tidal branch that heretofore carried sand and mud into Wappoo Cut, and a number of snags, stumps, and overhanging trees were removed.

No work has been done during the past fiscal year. It had been intended to expend the appropriation of $3,000, made available in July, 1884, in widening, deepening, and trimming the cut, by dredging, at points where it would be to the best advantage of navigation. Proposals were invited on January 5, 1885, for dredging in Wappoo Cut and on the bars of Ashley and Stono rivers.

No bids were received under this call. It was thought possible that later in the season a dredge might be hired, on acceptable terms, to perform the work for which proposals had been invited, and it was recommended that until then, or until additional funds should be provided, no readvertisement for proposals should be made. This recommendation was approved by the Department.

CONDITION AND EFFECTS OF THE WORK.

The improved portions of Wappoo Cut have maintained their depth during the year, but the available width has been reduced to about 45 feet, by washing and caving of banks. On this width a draught of of from 5½ to 6 feet can be carried through the cut.

An old abandoned lighter, said to have formerly belonged to the Marine and River Phosphate Company, drifted into Elliott's Cut in the latter part of June, 1885, and obstructed the passage. Soon afterwards, it was dragged out and left at anchor in Stono River about 200 yards from the mouth of the cut.

The commercial importance of Wappoo Cut as a sheltered inland route for the transportation of the product of a considerable area of country south of Charlestown, has been referred to in former reports. The staples shipped by this route are sea-island cotton, rice, and phosphate rock, with large quantities of naval stores and general merchandise.

OPERATIONS CONTEMPLATED DURING THE PRESENT FISCAL YEAR.

With the amount still available on July 1, 1885, operations will be continued at those points where local examinations shall show that the funds can be used to the best advantage. It is not probable that acceptable terms for dredging can be secured until another appropriation is made.

Since the approval of the project for this improvement the following appropriations have been made:

By act of Congress approved March 3, 1881	$10,000
By act of Congress passed August 2, 1882	10,000
By act of Congress approved July 5, 1884	3,000
Total	23,000

The total expenditures to June 30, 1885, were $19,972.16.

I have no further data to communicate in addition to statements made in former annual reports concerning the amount of commerce and navigation that would be benefited by completing the improvement of Wappoo Cut.

[This work is in the collection district of Charleston, S. C. Charleston is the nearest port of entry. Amount of duties collected on imports in 1884, $36,624.76.

The report of First Lieut. F. V. Abbot, Corps of Engineers, is transmitted herewith.

Money statement.

July 1, 1884, amount available		$27 84
Amount appropriated by act approved July 5, 1884		3,000 00
		3,027 84
July 1, 1885, amount available		3,027 84
{ Amount (estimated) required for completion of existing project		15,000 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1887		15,000 00
{ Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

REPORT OF LIEUTENANT FREDERIC V. ABBOT, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Charleston, S. C., June 30, 1885.

SIR: I have the honor to submit the following report on the present condition of the work done for improving Wappoo Cut, South Carolina, in previous fiscal years.

During the fiscal year ending June 30, 1885, no work has been done. An instrumental examination made in May, 1885, shows that the channel dredged in 1883 has shoaled only at one point. In other parts a tendency to scour deeper has been found to exist.

On June 23, 1885, an old abandoned lighter, belonging to the defunct Marine and River Phosphate Company, drifted into the part of the cut known as Elliott's Cut, and sunk there, entirely closing it for traffic. Five and a half feet can be carried through the cut at mean low water as soon as this obstruction is removed.

Very respectfully, your obedient servant,

FREDERIC V. ABBOT,
First Lieut. of Engineers.

Col. Q. A. GILLMORE,
Corps of Engineers, U. S. A.

N 3.

IMPROVEMENT OF ASHLEY RIVER, SOUTH CAROLINA.

Three appropriations have thus far been made by Congress for improving Ashley River, South Carolina, aggregating $4,500. The last of these appropriations, amounting to $2,000, made by act of Congress approved July 5, 1884, is still available.

Ashley River was examined and partially surveyed, under my direction, under a provision of the act of March 3, 1872. My report, with project of improvement, is printed as Appendix S 8 of the Annual Report of the Chief of Engineers for 1873.

The plan of improvement recommended comprised:

1. The removal of a shoal or bar at a place known as Accabbee, between 7 and 8 miles above Charleston City, where only 9 feet of water at mean low tide was found in 1873, while the channel of approach to it from below was only about 40 feet in width between the 10-foot curves.

2. The removal of a shoal at a point below the Wando Phosphate Works, about 2 miles above Accabbee, where only 6 feet of water was found at low tide.

It was proposed to lower these shoals, by dredging, to a low-water depth of from 10 to 11 feet.

The cost of the work was estimated at $5,000.

OPERATIONS PREVIOUS TO JUNE 30, 1884.

The first two appropriations, aggregating $2,500, were, with the exception of a balance of $85.07 remaining on hand when operations were closed, expended during the fiscal year ending June 30, 1882. A channel was dredged at a shallow crossing, near the Wando works, of about 100 feet width and 1,000 feet length, with an improved depth of 11 feet at mean low water.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1885.

On July 1, 1884, the sum of $2,085.07 was available for continuing the improvement of Ashley River. Operations were confined to making local surveys and examinations for the purpose of selecting points in

the river where dredging would be needed. It was found that the money could be spent to the best advantage at a shoal near the Stono Phosphate Works, about 9 miles above Charleston. Proposals for doing this work were invited on January 5, 1885. Only one bid was received, made by the Charleston Dredging Company, which offered to do the dredging at the price of 30 cents per cubic yard. This price was considered too high, and the rejection of the proposal was recommended. It was thought probable that more favorable terms could be obtained later in the season, and that it was best not to readvertise for proposals at the present time. These views of the question were concurred in by the Department, and nothing further was done in the matter to the close of the fiscal year.

An examination made in May, 1885, has shown that the cut dredged in 1882 has been maintained without shoaling.

In former annual reports I have had occasion to invite attention to the question of the permanency of the improved channel thus far gained by dredging in Ashley River. I have no doubt that, in order to maintain the depths where work has been done, it will be necessary not only that dredging be repeated occasionally, but also that wing-dams should be built at the crossings to direct and concentrate the currents, with the view of rendering the improvement of the channel practically permanent. Such works were not included in the project of improvement; their construction would materially increase the aggregate cost of the modified plan over the original estimate, which provided only for dredging.

This improvement directly aids the business of the several phosphate works located above the shoals referred to, and thus indirectly benefits the commerce of the city of Charleston.

This work is located in the collection district of Charleston, S. C. Charleston is the nearest port of entry. Amount of duties collected in 1884, $36,624.76.

Since the plan of improvement was adopted, the following appropriations have been made:

By act of Congress approved June 14, 1880	$1,000
By act of Congress approved March 3, 1881	1,500
By act of Congress approved July 5, 1884	2,000
Total	4,500

The total expenditures to June 30, 1885, were $2,445.43.

The report of First Lieut. F. V. Abbot, Corps of Engineers, is transmitted herewith.

Money statement.

July 1, 1884, amount available	$85 07	
Amount appropriated by act approved July 5, 1884	2,000 00	
		2,085 07
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884		30 50
July 1, 1885, amount available		2,054 57
Amount (estimated) required for completion of existing project		1,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		1,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

Abstract of proposal for dredging in Ashley River, South Carolina, opened January 26, 1885.

No.	Name of bidder.	Price per cubic yard.	Date of commencement.	Date of completion.
1	Charleston Dredging Company.....	$0 30	March 1, 1885.	April 1, 1885.

Proposal rejected, the price being deemed too high.

REPORT OF LIEUTENANT FREDERIC V. ABBOT, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Charleston, S. C., July 1, 1885.

SIR: I have the honor to submit the following report on the present condition of the work done in previous fiscal years for the "improving Ashley River, South Carolina":

No work has been done during the fiscal year ending June 30, 1885. An examination made in May, 1885, shows that the cut dredged in 1882 has been maintained without shoaling. Eleven feet can be carried through at mean low water.

Very respectfully, your obedient servant,

FREDERIC V. ABBOT,
First Lieut. of Engineers.

Col. Q. A. GILLMORE,
Corps of Engineers, U. S. A.

N 4.

IMPROVEMENT OF EDISTO RIVER, SOUTH CAROLINA.

By the river and harbor act passed August 2, 1882, the sum of $8,000 was appropriated for improving Edisto River, South Carolina. This was the first appropriation made by Congress for this work. By the act approved July 5, 1884, a second appropriation was made amounting to $5,000.

The Edisto is one of the principal rivers of South Carolina. It is formed by the junction of the North and South forks, which unite in the southern part of Orangeburg county. The South Fork, commonly known as the South Edisto, is the main river. It empties into the ocean near Saint Helena Sound.

Edisto River was examined under my direction, with a view to its improvement, in September and October, 1880. My report, dated December 31, 1880, with project of improvement, is printed as Appendix J 15 of the Annual Report of the Chief of Engineers for 1881, and also as part of House Ex, Doc. No. 23, Forty-sixth Congress, third session.

It is contemplated to improve the river from Guingard's Landing, in Aiken county, to the mouth, a total length of 260 miles, so as to establish a safe navigation at all seasons of the year for light draught-steamboats from the sea to the junction of North and South forks, near the crossing of the South Carolina Railroad, 183 miles from the mouth, and thence to Guingard's Landing for rafts and flat-boats. It is not deemed advisable to attempt an improvement of the reaches higher up, which are excessively encumbered with logs and shoals.

The obstructions to navigation consist of numerous bends, logs, snags, overhanging trees, and piles, and also of shoals, composed generally of sand, but in some places of hard clay.

The project of improvement comprises the following details of work:

(1) Enlargement and clearing of all the new channels now in process of formation.

(2) Forming new channels across necks of bends where needed.

(3) Shutting off lateral arms which now weaken the stream.

(4) Removal of logs, snags, and pile obstructions.

(5) Removal of shoals of sand and clay; in one case by building a deflecting jetty.

The total cost of the project was estimated at $33,385.

At the present time there exists no reason for augmenting this original estimate.

OPERATIONS PREVIOUS TO JUNE 30, 1884.

The work of improving Edisto River has been carried on mainly by the United States snag-boat Toccoa, originally built for use on the Savannah and Altamaha rivers, Georgia. The operations extended from the mouth of the Edisto to a point 75 miles above Jacksonborough, an aggregate length of 114 miles by river. Pile obstructions placed during the civil war were removed at Milltown, at the mouth of Mill Creek, and at the Charleston and Savannah Railroad Bridge, at Jacksonborough, within a distance of from 30 to 39 miles from the mouth. From the reaches between Jacksonborough and a point 75 miles higher up 483 snags, logs, and leaning trees were removed. A short cut-off was opened through the neck of a troublesome bend three-fourths of a mile long known as "The Suck," 50 miles above Jacksonborough; it is now used as the regular channel for navigation.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1885.

At the beginning of the fiscal year an amount of $6,860.20 was available for continuing the improvement of Edisto River, including the appropriation made by act approved July 5, 1884.

The snagboat Toccoa was engaged for a short time in improving the reaches from a point 10 miles above Jacksonborough to Kennedy's (or Canaday's) Bridge, 81 miles higher up. From twelve to one hundred and ninety men were employed at various times in removing logs and trees, closing numerous outlets into the swamps forming the banks of the river, as well as several of those incipient cut-offs known as "sucks," from their tendency to draw log rafts against the banks; 5,798 overhanging trees were cut down and removed, and 4,942 snags varying from 12 to 72 inches in diameter were taken out of the bed. Banks were trimmed at many places.

This work was not performed by contract, because from its nature no proposal could be made without an excessive margin for contingencies.

The navigation of the river has been materially improved on the reaches where operations have been carried on. Raftsmen say that the time needed for the delivery of lumber to market has been much reduced.

It is recommended that the necessary appropriation be made by Congress to complete the work in accordance with the existing project. The benefits that will accrue to commerce and navigation from fully carrying out the project were briefly commented upon in my report of December 31, 1880.

From the beginning of work to June 30, 1885, the total expenditures were $12,629.86.

No appropriation having been made for improving Edisto River at the last session of Congress, no plan of operations for continuing the improvement is submitted.

Since the present project of improvement was adopted the following appropriations have been made:

By act of Congress passed August 2, 1882	$8,000
By act of Congress approved July 5, 1884	5,000
Total	13,000

To complete the work of improving Edisto River, in conformity to the approved project additional appropriations are required to the aggregate amount of $20,385.

This improvement is located in the collection district of Charleston, S. C., Charleston and Beaufort, S. C., and Savannah, Ga., are the nearest ports of entry. Duties on imports collected at the custom-house of Charleston during the calender year 1884, $36,624.76.

The report of First Lieut. F. V. Abbot, Corps of Engineers, is transmitted herewith.

Money statement.

July 1, 1884, amount available	$1,860	20
Amount appropriated by act approved July 5, 1884	5,000	00
	6,860	20
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	6,490	06
July 1, 1885, amount available	370	14
Amount (estimated) required for completion of existing project	20,385	00
Amount that can be profitably expended in fiscal year ending June 30, 1887	10,000	00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

REPORT OF LIEUTENANT FREDERIC V. ABBOT, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Charleston S. C., July 1, 1885.

SIR: I have the honor to submit the following report of work done for improving Edisto River, South Carolina, during the fiscal year ending June 30, 1885:

Five days' work was done on this river by the United States snag-boat Toccoa in the month of July, 1884, and from that time till the appropriation was expended work was done by hired labor.

Many outlets into the swamps which form the banks of this river were closed, as well as incipient cut-offs, locally known as "sucks," from their tendency to draw log rafts against the banks. Five thousand seven hundred and ninety-eight overhanging trees were cut down and placed where they would not fall into the river, and 4,942 snags, varying from 12 to 72 inches in diameter, were taken out of the bed.

Great improvement of the river has resulted, and raftsmen say that the time needed for the delivery of timber to market has been much reduced.

Very respectfully, your obedient servant,

FREDERIC V. ABBOT,
First Lieut. of Engineers.

Col. Q. A. GILLMORE,
Corps of Engineers, U. S. A.

N 5.

IMPROVEMENT OF SALKIEHATCHIE RIVER, SOUTH CAROLINA.

Two appropriations have thus far been made by Congress for the improvement of Salkiehatchie River, South Carolina, aggregating $8,000.

The river was examined under my direction during the latter part of 1880, and my report of the examination, dated December 29, 1880, is printed as Appendix J 16, Annual Report of the Chief of Engineers,

1881, and as part of House Ex. Doc. No. 23, Forty-sixth Congress, third session.

The Salkiehatchie River, also named the Big Salkiehatchie, to distinguish it from one of its tributaries known as the Little Salkiehatchie, rises in Aiken county, South Carolina. These two rivers unite about 80 miles from the Atlantic sea-board. About 24 miles below the junction the Salkiehatchie is spanned by the Charleston and Savannah Railroad Bridge. Further down the river is known as the Combahee, which discharges into Saint Helena Sound, about midway between the cities of Charleston and Savannah.

The mean rise and fall of tides in Saint Helena Sound is 5.9 feet. At the railroad crossing, nearly 60 miles from the river's mouth, it is 2.5 feet, and the tidal oscillation reaches a point about 20 miles higher up.

PROJECT OF IMPROVEMENT.

The project contemplates the creation of a continuous and practicable channel for rafts and flat-boats in the lower reaches of the river from a point 5 miles above Toby's Bluff down to Hickory Hill, 12 miles below the railroad bridge and 46 miles above the river mouth, comprising a total length of river of 77 miles.

The work would comprise the removal of piles at Hickory Hill, and the removal of logs and of the shoals accumulated around them in the reaches above the bridge.

Through Murdock's and Weekly Sand Drags, where the Salkiehatchie divides into numerous insignificant streamlets, cuttings must be made to form a channel of sufficient dimensions for rafts and flat-boats. The cost of this improvement is estimated at $18,000. It is believed that the original estimate of the cost of the improvement will not be exceeded.

OPERATIONS PREVIOUS TO JUNE 30, 1884.

The United States snag-boat Toccoa removed 16 piles to clear the channel, which had been obstructed at Hickory Hill, 12 miles below the Charleston and Savannah Railroad Bridge, by a double row of piles driven during the civil war; also 106 snags, overhanging trees, and stumps from the channel between these points. The operations of the boat had to be confined to this part of the river, as the bridge prevented it from passing above. From the bridge to the "Roots," 32 miles above, where raft navigation was much impeded by numerous logs and snags and by some shoals, hired labor was employed in removing 1,750 snags and similar obstructions.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1885.

For continuing the improvement of the Salkiehatchie during the past fiscal year the sum of $4,410.35 was available, including the appropriation of $3,000 made by act of Congress approved July 5, 1884.

The operations extended from the railroad bridge up-stream to the vicinity of Braxton's Ford, a total length of about 80 miles. The lower reach of 21 miles, from the bridge to the "Forks," was entirely cleared of obstructions. From the "Forks" to Braxton's Ford, a reach of 59 miles, a considerable amount of work was performed for improving raft navigation, by removing obstructions, straightening the bed of the river, and concentrating its currents by shutting off lateral channels. The

number of snags removed during the working season, together with some stumgs and overhanging trees, amounted to 9,490 in the aggregate; more than a hundred outlets were closed; two shoals or islands were removed; twenty-six mud and sand points were cut off, and the banks were trimmed in numerous places. For reasons stated, the snag-boat was not used above the railroad bridge. It would not have been possible to do the work described by contract, except by consenting to an unreasonable margin for contingencies, and hired labor was therefore employed with entirely satisfactory results.

Operations were suspended in May last, the funds having been almost exhausted.

The raft navigation has been greatly benefited on the reaches from Toby's Bluff to the "Forks," a distance of about 35 miles, by reducing the slope and increasing the low-river depth about 6 inches. From the "Forks" to the railroad bridge the improvement is practically completed. Rafts sent down the improved reaches are now made much larger, and the trips consume less time than formerly. From the railroad bridge to the point where the Salkiehatchie enters Saint Helena Sound, a length of about 60 miles, a safe channel is afforded to rafts, schooners, and light-draught steamboats since the 12-mile reach between the bridge and Hickory Hill has been cleared of obstructions. The counties directly benefited by this improvement are Barnwell, Beaufort, Hampton, and Colleton, all in South Carolina, with an aggregate population of 125,160 by the census of 1880.

In view of the favorable results already effected, it is recommended that a further appropriation be made to complete the existing project.

From the beginning of the work to June 30, 1885, an aggregate sum of $7,858.90 has been expended on this improvement.

Since the adoption of the existing plan of improvement the following appropriations have been made:

By act of Congress passed August 2, 1882	$5.000
By act of Congress approved July 5, 1884	3,000
Total	8,000

The estimated cost of the project is $18,000, and a further appropriation of $10,000 is needed to complete it.

This work is located in the collection district of Charleston, S. C. Beaufort is the nearest port of entry.

The report of First Lieut. F. V. Abbot, Corps of Engineers, is transmitted herewith.

Money statement.

July 1, 1884, amount available	$1,410	35
Amount appropriated by act approved July 5, 1884	3,000	00
	4,410	35
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	4,269	25
July 1, 1885, amount available	141	10
Amount (estimated) required for completion of existing project	10,000	00
Amount that can be profitably expended in fiscal year ending June 30, 1887	10,000	00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

REPORT OF LIEUTENANT FREDERIC V. ABBOT, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Charleston, S. C., July 1, 1885.

SIR: I have the honor to submit the following report on the work which has been done in improving Salkiehatchie River, South Carolina, during the fiscal year ending June 30, 1885:

Work has been carried on entirely by hired labor. It has consisted largely of the removal of snags and overhanging trees, and to a less extent of work done in closing some of the numerous outlets which allow the water of the river to be dissipated in the swamps which bound it on either side; 9,390 snags have been removed, 100 overhanging trees have been felled, and 131 outlets have been closed. Several small islands have been dug away, and in some cases sandy points that interfered with raft navigation have been cut off.

Great improvement of the river has resulted, and the raftmen express great satisfaction at the results obtained.

Very respectfully, your obedient servant,

FREDERIC V. ABBOT,
First Lieut. of Engineers.

Col. Q. A. GILLMORE,
Corps of Engineers, U. S. A.

N 6.

IMPROVEMENT OF SAVANNAH HARBOR AND RIVER, GEORGIA.

Operations for improving Savannah Harbor and River, Georgia, during the past fiscal year were conducted in conformity with the enlarged project based upon an examination made in compliance with section 3 of the river and harbor act approved March 3, 1881. It was provided in that section that an examination or survey, or both, with estimates of cost of improvement proper, should be made in the Savannah River to increase the depth of water in said river and harbor, from the bar up to the city, to 22 feet, and to make an estimate of the cost of widening the channel of the Savannah River opposite the city to 600 feet, of uniform depth with the balance of the channel.

My report of this examination, dated January 16, 1882, is found in the Annual Report of the Chief of Engineers, 1882, as part of Appendix J 4, and is printed as Senate Ex. Doc. No. 19, Forty-seventh Congress, first session.

During the two years preceding the autumn of 1873 Congress had appropriated the aggregate sum of $100,000 for improving the river below the city of Savannah, which was expended mainly in removing wrecks, cribs, and other obstructions.

By act approved February 27, 1874, the sum of $193,132.96 was appropriated for the relief of Mr. Henry S. Wells, for work done by him in removing wrecks, cribs, &c., under contracts with the Treasury Department of May 1 and July 5, 1866.

PLAN OF IMPROVEMENT.

The project under which operations have lately been carried on is an enlargement of two previous projects, dated August 28, 1873, and March 19, 1879, respectively. These two projects embraced the following general details of work:

Widening the water-way at the city front.

Deepening, widening, and straightening the channel by dredging at various points below the city to the vicinity of Tybee Roads.

A dam at the Cross Tides, 4 miles above the city.

A short bulkhead on the Hutchinson's Island side, opposite the upper part of the city.

Adopting the north channel of the Savannah River for final improvement, in preference to the south channel, from the head of Elba Island to the head of Long Island, which required the construction of a low dam across the upper end of the south channel, closing the lateral channels connecting the north channel with the south channel, from Elba Island to Cockspur Island, and some shore protection, such land along the water-front on Hutchinson's Island and Fig Island, opposite the city of Savannah, as might be needed in widening the channel-way at these localities, was to be purchased.

The enlarged project embraced in my report of January 16, 1882, comprised in substance the features of the two previous plans, and provided in addition for a number of works, chiefly wing-dams, that are considered to be necessary for the further improvement of the channel of navigation from Tybee Roads to the city of Savannah, with a view of rendering the improvement practically permanent. For the details of this project I beg leave to refer to my annual report for the year ending June 30, 1882.

The total cost of the improvement according to the enlarged project of January 16, 1882, was estimated at $730,000, in addition to the sum of $482,000 appropriated previous to that date.

OPERATIONS PRIOR TO JULY 1, 1884.

At Cross Tides, 4 miles above the city of Savannah, a submerged dam was constructed, formed of brush mattresses and riprap stone. In June, 1882, the work had reached a height of 3 feet above low water, but it gradually settled afterward. In June, 1884, its crest, for one half its length, was at the level of low water, and for the other half from 3 to 7 feet lower. This dam had been designed to reduce the column of water diverted down Back River, and to increase the ebb flow in Front River, past the city front, where it is most needed for navigation. It became evident that the dam, in order to be effective and secure from settling by under-scour, must be raised to the level of high water.

About 70 feet in length of the old King's Island crib jetty, near the Cross Tides, was removed to facilitate the flow of water into Front River.

Between King's Island and Hutchinson's Island, and lower down the Front River (or Savannah River proper) to the city of Savannah, sand and mud aggregating about 96,500 cubic yards were removed by dredging to aid the influx of the tide.

Dredging to an aggregate amount of 269,632 cubic yards was done in front of the city, to increase the depth of water on Garden Bank Shoal, and to widen the river to 660 feet by cutting off the projecting point of Fig Island, opposite the wharves of the Savannah, Florida and Western Railroad.

Three wing-dams, composed of log mattresses and riprap stone, were constructed opposite the lower part of the city, in order to increase the strength of the currents by reducing the width of the water-way at Garden Bank Shoal. Their shore ends rest on Fig Island. They contract the water-way to about 660 feet; the width was formerly from 900 to 1,050 feet.

An aggregate of 558,628 cubic yards of material has been removed by dredging from the new channel at "The Wrecks," during the years from 1876 to 1884. Previously about 142,000 cubic yards had been removed

from the old Fig Island Channel, the improvement of which was abandoned in 1875, as recommended in my letter to the Chief of Engineers dated May 13, 1875.

A jetty or training-wall, formed of courses of log and brush mattresses and riprap stone, was built for a length of about 6,000 feet eastward or down-stream from a point a little above the lower end of Fig Island, with which it is connected by a return of about 160 feet. The down-stream end of the jetty rests in 15 feet water at low tide, and the top of the work was carried to a height of 2 or 3 feet above that level. Eleven short spurs on the channel side of the jetty, placed at right angles to the line of "The Wrecks" Channel, were constructed for better concentrating the currents. The heads of the spurs are so aligned that the low-water width of the water-way increases from 680 feet at the upper spur to 740 feet at the lowest spur. A similar spur-jetty was built about 480 feet above the shore end of the Fig Island jetty, to regulate the ebb flow from Front River into the channel at "The Wrecks." These several spurs rise from 2 to 6 feet above the level of mean low water.

Two dams (numbered 5 and 11½) were built to close lateral channels to the northwest and southeast of Barnwell Island, opposite Fort Oglethorpe. They rise from 2 to 6 feet above the level of mean low water, and are intended to increase the flow of water in the main channel abreast of the head of Elba Island.

A submerged dam was partly constructed across the south channel of Savannah River between the head of Elba Island and Saint Augustine Creek. By partially closing this branch it is designed to increase the ebb flow in the north channel, which is the channel for navigation. It may not be necessary to complete this dam.

A wing-dam (numbered 15) extends eastward from a little mud island, named Barnwell Island No. 3, toward the upper end of Elba Island, reducing the width of the water-way, previously nearly 2,000 feet, to about half that amount.

Three lateral channels, formerly connecting the north channel with the south, have been closed. One of the dams shuts off Philbrick's Cut, at the lower end of Elba Island; another, "Big Gap Dam," passes across the channel between Island One and Two and Bird Island; and the third dam closes the two channels between Bird Island and Long Island.

A pair of wing-dams (numbered 4 and 23) was built to contract the water-way at the eastern end of the passage between Spirit Island and the main shore of South Carolina. They are placed opposite each other. Present width of water-way, 1,044 feet.

A second pair of wing-dams (numbered 6 and 25) was built about 800 yards farther down, where the natural width was 3,700 feet. The new water-way was designed to be 1,050 feet wide, but, by some oversight in locating the work, it was made only 877 feet. This is evidently too narrow, but no change is contemplated at the present time, nor until the final results developed shall indicate a change to be necessary.

A third pair of wing-dams (numbered 14 and 29) was commenced at the upper end of the Lower Flats, or Cabbage Tree Crossing, opposite each other, the shore end of number 14, starting from a point very near to the lower end of Elba Island. The width is here 2,400 feet.

Some 2,300 feet below, on the right bank, about two-thirds of wing-dam number 13 was built. Its shore end is near the foot of Island One and Two. It is designed, in conjunction with numbers 14 and 29, to

maintain the improved depth on Cabbage Tree Crossing, expected to result from increased scour and from dredging.

From that portion of the river known as the "Obstructions," at the head of Elba Island, down to Tybee Knoll, material to the amount of 502,360 cubic yards was removed by dredging prior to June 30, 1884; and a number of wrecks of large vessels, and portions of wrecks, as well as piles and other obstructions, were taken from the ship-channel.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1885.

With an appropriation of $200,000 made by act of Congress approved July 5, 1884, and a balance of $1,074 on hand July 1, 1884, the sum of $201,074 was available for continuing the improvement of Savannah Harbor and River during the fiscal year just closed.

The operations consisted in continuing the construction of wing dams in the lower part of the river, in raising some dams previously constructed to a higher level, and in dredging at various point. A considerable amount of field work was accomplished in local surveys and soundings, for the purpose of locating new works and of noting changes in the condition of the channel-way.

Proposals for building dams, wing-dams, and training-walls in Savannah Harbor and River were invited on July 26, 1884. These various kinds of work, as heretofore, included building dams composed of successive courses of log and brush mattress overlaid with riprap stone, and putting riprap stone on work already in place wherever required.

The mattresses placed during the past season differed in some respects from those made under the preceding contracts, particulars of which were given in my annual report for the fiscal year ending June 30, 1883.

The new specifications were as follows:

The mattress is simply a raft of round logs, not less than 12 inches in average diameter, and not less than 9 inches in diameter at the small end, placed in close contact, side by side, at right angles to the wall or dam, and firmly held by transverse binders spiked or bolted to them. The binders will be smaller logs or poles, not less than 5 inches in diameter at the small end, and placed not more than 8 feet apart, and those on the outside will be close to the ends of the logs.

The spaces between the binders will be closely filled up with compact bundles of brush, placed parallel to the logs of the mattress, to such depth as to give a thickness of not less than 6 inches when compacted in the finished work, secured in place by pole binders in such a manner as the engineer in charge shall approve.

The logs and binders used may be of loblolly or other cheap variety of pine, and must be of gentle taper and sufficiently straight, and the brush will be live hard-wood brush. Logs will not be used that do not fit close enough to hold the stone safely, even without the aid of brush.

The mattress will be laid in sections of convenient length in juxtaposition, or with such laps as the engineer in charge shall direct, and each section will be made of the full width of the mattress course, as fixed by the engineer in charge during the progress of the work.

Gaps between the edges of adjacent sections of mattress will be filled with stone by the contractor, to be paid for at a price equal to the price of the mattress work.

The stone will be sound, dense, of compact form, and of suitably random sizes, varying in weight from 15 to 200 pounds. When received by weight 2,800 pounds will be required to the cubic yard. When received by measurement the stone will be fairly piled upon scows or lighters.

Loads of stone submitted for measurement that contain any appreciable quantity of defective stone, or that are loosely or not fairly loaded, or so loaded that they cannot be accurately measured, will not be accepted.

Four bids were received, of which one offered by Mr. John F. Gaynor, of Fayetteville, N. Y., was the lowest. His prices were 47 cents per square yard of mattress, and $3.05 per cubic yard of stone put in place. With the approval of the Chief of Engineers, a contract was concluded on September 1, 1884, with Mr. Gaynor.

On September 18, 1884, proposals were invited for removing from 90,000 to 150,000 cubic yards of material, by dredging at various points on the Savannah River, between the Cross Tides and Fort Pulaski. Two bids were received, one from Mr. J. Paulsen, Savannah, Ga., and the other from the American Dredging Company, Philadelphia, neither of which was accepted, the price not being deemed low enough. The work was readvertised on November 3, 1884, when again two proposals were obtained, one from Mr. Paulsen, the other from Mr. P. Sanford Ross, of Jersey City, N. J. The latter's bid of 17¾ cents per cubic yard for all dredging from Cross Tides to Fort Pulaski was the lowest, and its acceptance was recommended to and approved by the Department. A contract was made with him on November 26, 1884.

Mr. Ross was allowed six weeks' time from the date of his contract to begin operations, as he represented that he intended to build a new dredge and scows for this work. He could not complete his preparations within that period, and a further extension of time was granted him; but it being found that dredging was urgently needed at various places below the city, where large steamers frequently grounded, a special agreement was, under authority of the Department, entered into on January 22, 1885, with Mr. J. Paulsen, of Savannah, to put his dredge to work at the price named in Mr. Ross's contract, and for a length of time equal to the interval between December 17, 1884, at which date Mr. Ross had at first agreed to begin and the day when he would actually be ready to commence operations. This agreement with Mr. Paulsen remained in force until April 13, 1885, soon after which time Mr. Ross began work under his contract.

Operations on dams under Mr. Gaynor's contract were begun October 27, 1884, and were still in progress at the close of the fiscal year.

Cross Tides Dam.—Owing to insufficient height of the dam the overflow of the ebb tide eastward, in the direction of Back River, had scoured on the east side a hole more than 40 feet deep at mean low water. The stability of the work being seriously compromised at that point, an apron of log mattresses from 40 to 70 feet wide, overlaid with stone, was placed here along the base of the dam, and the dam itself raised to the level of high water with brush fascines loaded with stone.

Wrecks Channel, Fig Island Jetty.—This jetty had settled about 3 feet below low water at the point where it crosses the old Fig Island Channel, and to some extent in other places. Too much water evidently escaped northward, to the detriment of the channel at The Wrecks, and it was decided to raise the work to about 5 feet above low water. At the close of the fiscal year about two-thirds of the aggregate length of low plcaes in the jetty had been raised to the required height, using mainly brush fascines and riprap stone.

Upper Flats Crossing.—Wing-dams Nos. 10 and 27 were built to improve the lower part of Upper Flats. No. 10 rests on Elba Island; No. 27 is opposite to it, but does not extend to the shore of the South Carolina mainland leaving a gap of about 1,500 feet. The width of the

river is here 4,000 feet. By the construction of the dams the practicable water-way has been reduced to about 1,200 feet.

Lower Flats or Cabbage Tree Crossing.—Wing-dams Nos. 14 and 29, previously commenced, were completed during the past fiscal year. No. 14 starts from the lower end of Elba Island, and No. 29 is opposite to it. A water-way 1,300 feet wide is left open between the channel ends of the dams, the full width of the river being about 2,500 feet.

Long Island Crossing.—Wing-dams Nos. 26 and 33 were built at this crossing, where the ebb currents are deflected from the shore of Jones Island southward to the opposite shore of Long Island. The river is here nearly 3,100 feet wide. Dam No. 26 has its shore end at a point near the upper end of Long Island, and dam No. 33 is opposite to it, leaving a clear water-way 1,300 feet wide.

Mouth of River.—Where some dredging had been done to improve the channel across Oyster Bed Shoal, northwest of Fort Pulaski, it was observed that very strong ebb currents still set in north of Oyster Bed toward the abandoned north channel, and it became doubtful whether dredging alone would suffice in this locality. Some one of the works suggested in my report and project of January 16, 1882, seemed to be needed here, and it was finally decided to build a dam (No. 31) to extend from a southerly point of Turtle Island southeast to the western part of Oyster Bed, between the Quarantine Station and Oyster Bed (red light) beacon. This work, commenced in May last, is still in progress. About 2,700 linear feet of its length has been laid from the Oyster Bed to a point near a shoal dry at low water and about 2,600 feet from Turtle Island. About one-half of the portion thus far built rises to the level of mean low water; the other parts are from 3 to 6 feet lower.

The bottom mattresses of the wing-dams described in this report vary from 30 to 80 feet in width, according to the depth of water in which they were sunk; the width gradually diminishes in building up, and the top courses are all 15 feet wide. When finished their crests rise 5 or 6 feet above low water.

The channel ends of six of the finished wing-dams below the head of Elba Island were marked, each with a group of three heavy piles driven about 25 feet into the ground, bound together by two or three turns of five-eighths inch chain spiked to the piles.

The material used in constructing dams during the past fiscal year aggregated 105,096 square yards of log mattress, 5634.5 cubic yards of brush fascines, and 21,203 cubic yards of riprap stone.

Dredging.—The bulk of the material removed by dredging during the past fiscal year was taken from "Wrecks" channel (39,764.95 cubic yards), from the lower end of Upper Flats (21,368 cubic yards), and from the Oyster Bed channel, northwest of Fort Pulaski (27,527.75 cubic yards); 9,455.5 cubic yards were removed from Garden Bank Shoal and from a little shoal above. The dredged material aggregated 98,114.2 cubic yards, of which amount 67,542.75 were removed by Mr. Paulsen, and the balance by Contractor Ross. Dredging was suspended at the end of May, 1885, to be resumed in September or October next.

CONDITION AND EFFECT OF THE WORKS.

Cross Tides Dam.—Just before the close of the fiscal year the recently raised central portion of the dam was washed out to the level of low water for a length of about 150 feet. This is believed to be mainly due to the removal of stone by some fishermen, who strongly object to rais-

·ing this dam to high water, because it prevents their taking their boats to the city by the shortest route. The damage is being repaired.

In front of Savannah City.—By removing a part of a little shoal near the foot of West Broad street, a channel has been secured 22 feet deep at high water, with a width of not less than 100 feet. The three wing-dams at Garden Bank Shoal have not settled, and are in good condition. The minimum high-water sounding on the shoal is 20 feet.

Channel at "The Wrecks."—Where the Fig Island jetty had not settled, and where it has been raised during the past fiscal year, silt has rapidly collected over the work, and the growth of marsh grass is extending. Here, as well as some of the closing dams, quantities of rip-rap stone have recently been removed surreptitiously by unknown persons, presumably to reopen a convenient passage for boats. These facts were discovered before much injury was done, but it appears that it will be necessary to adopt special measures to prevent renewed depredations.

Some defective places still exist in this channel. The least mean high-water sounding on the sailing line is a little over 20 feet; the greatest, 25.6 feet. The upper and lower portions of the channel have deepened during the year 1 or 2 feet, while at some points of the middle portion a deepening of over 5 feet has taken place.

Channel at the "Obstructions."—This shoal separates the 15-foot low-water curves of the channel just west of the head of Elba Island. This troublesome crossing has not changed sensibly during the year. The channel over the shoal affords a little over 20 feet depth at mean high water. It may be necessary to raise the submerged dam at the entrance of the south channel to a higher level, so as to increase the flow of water at the "Obstructions," and save the expense of periodical dredging. As first projected, a channel-way for steamers is to be left over the central portion of this dam. Wing-dam No. 15, near the "Obstructions," is in good order.

Savannah River below head of Elba Island.—Wing-dams Nos. 4 and 23, lower end of Spirit Island, are in good order. The next pair below, Nos. 6 and 25, have settled from 3 to 6 feet at a few points.

The improvement of the channel at Upper Flats during the year has been marked, and still continues. There is now an available channel of 22 feet depth at mean high water, with a minimum width of 350 feet; formerly 18½ feet could not be found on this reach.

Of the new wing dams, Nos. 10 and 27, at the lower end of Upper Flats, the latter has settled 1 or 2 feet at some places. The gap left between isolated Dam No. 27 and the north shore is rapidly silting up. These dams have already produced a deepening of the channel at the lower end of the Upper Flats of 3½ feet as compared with former conditions. The width of the 22-foot high-water channel in the vicinity is nowhere less than 100 feet, with a prospect of further widening and deepening.

Dams Nos. 14 and 29, lower end of Elba Island, are in good order, and have been useful in effecting an improvement of Cabbage Tree Crossing, just below. The channel here is at present nowhere less than 20½ feet deep at mean high water, with a width of 200 feet, while formerly the available depth was less than 17 feet.

Wing-dam No. 13, about 2,200 feet below No. 14, remains in an unfinished condition.

Wing-dams numbers 26 and 33, recently completed, have settled at some points from 4 to 6 feet. Long Island Crossing, which this pair of wing-dams was designed to improve, offers at present a 22-foot high-

water channel with a width of 300 feet. Formerly there was here a practicable depth of less than 20 feet.

The dredging lately done in Oyster Bed Channel, near Spar Buov No. 11, has resulted in connecting the deep water pockets above and below the shoal by a channel through the shoal 400 feet wide and 22 feet deep at mean high water. Previously the depth had been 20½ feet. By completing Dam No. 31, in the vicinity, it is expected that the improved depths will be maintained.

Closing dams.—The several dams built two and three years ago to close lateral channels are in good condition, except that Big Gap Dam and the dam at Philbrick's Cut have settled in places to 2 or 3 feet below mean low water. They will be brought up to the level of high water before the close of operations now in progress.

The present condition of Savannah Harbor and River in regard to navigation is on the whole very satisfactory; better, indeed, than at any former period. A number of vessels, mostly large steamers, grounded during the year at some places in the channel between the city and Fort Pulaski; but this is to be ascribed to the fact that a high-water depth of 22 feet has not yet been continuously established, and that, owing to the improvements already effected, vessels at Savannah are now loaded deeper than formerly. In some cases proper allowance for the stage of tide was not made in going down stream. In many instances the vessels, when they grounded, were not in the best water, although approximately on the line of the former channel. Pilots, as a class, do not seem to adapt themselves readily to amended sailing lines.

I urgently recommend that an early and liberal appropriation be made by Congress for continuing, if not for completing, the work of improving Savannah Harbor and River.

OPERATIONS CONTEMPLATED DURING THE PRESENT FISCAL YEAR.

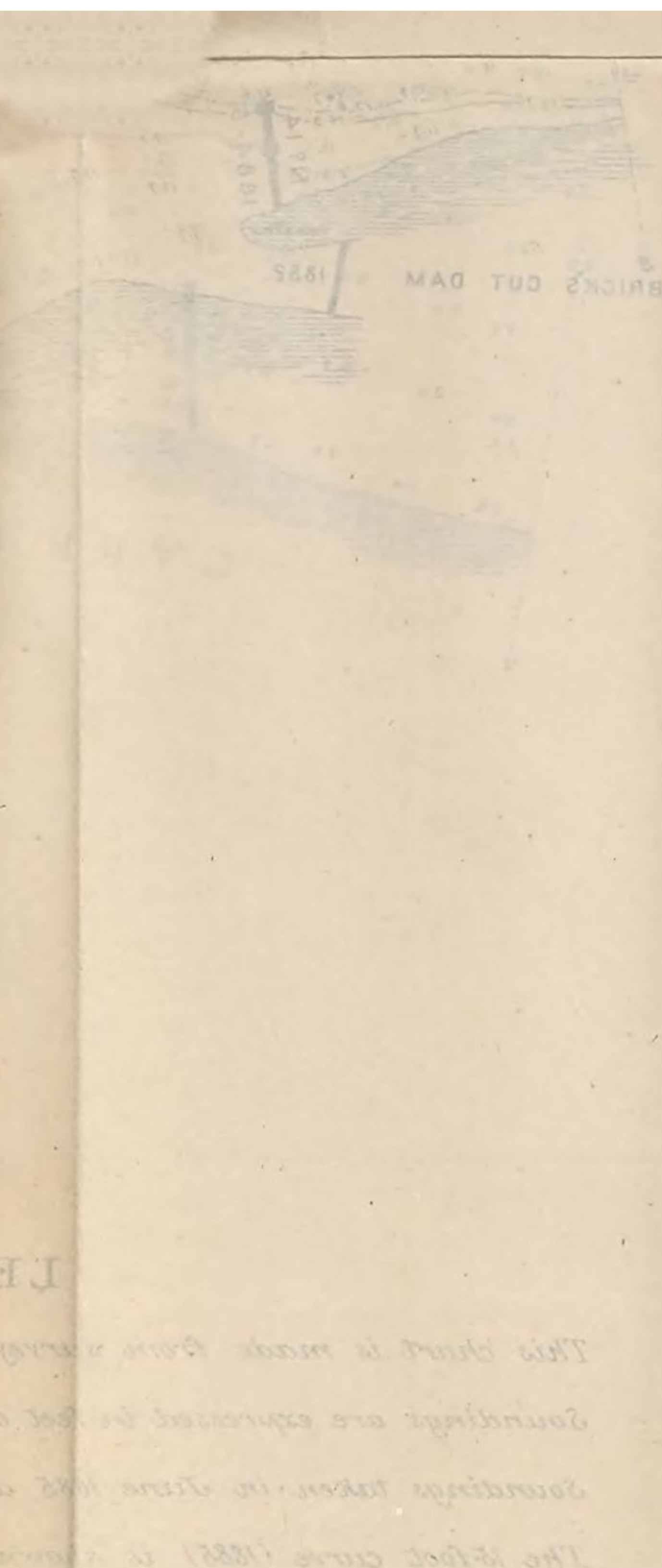
With the balance of funds on hand on July 1, 1885, amounting to $50,385.60, Dam No. 31, at the Oyster Bed, will be extended and raised; Cross Tides Dam repaired and its crest brought up to high water; the crest of Fig Island Jetty will be ralsed to a uniform level, and the low places of the dam at Philbrick's Cut and of Big Gap Dam built up to high water. Dredging will probably be resumed next October under the existing contract, it being the intention with the small balance available for this purpose to put the river in the best condition possible for meeting the demands of the next cotton-shipping season.

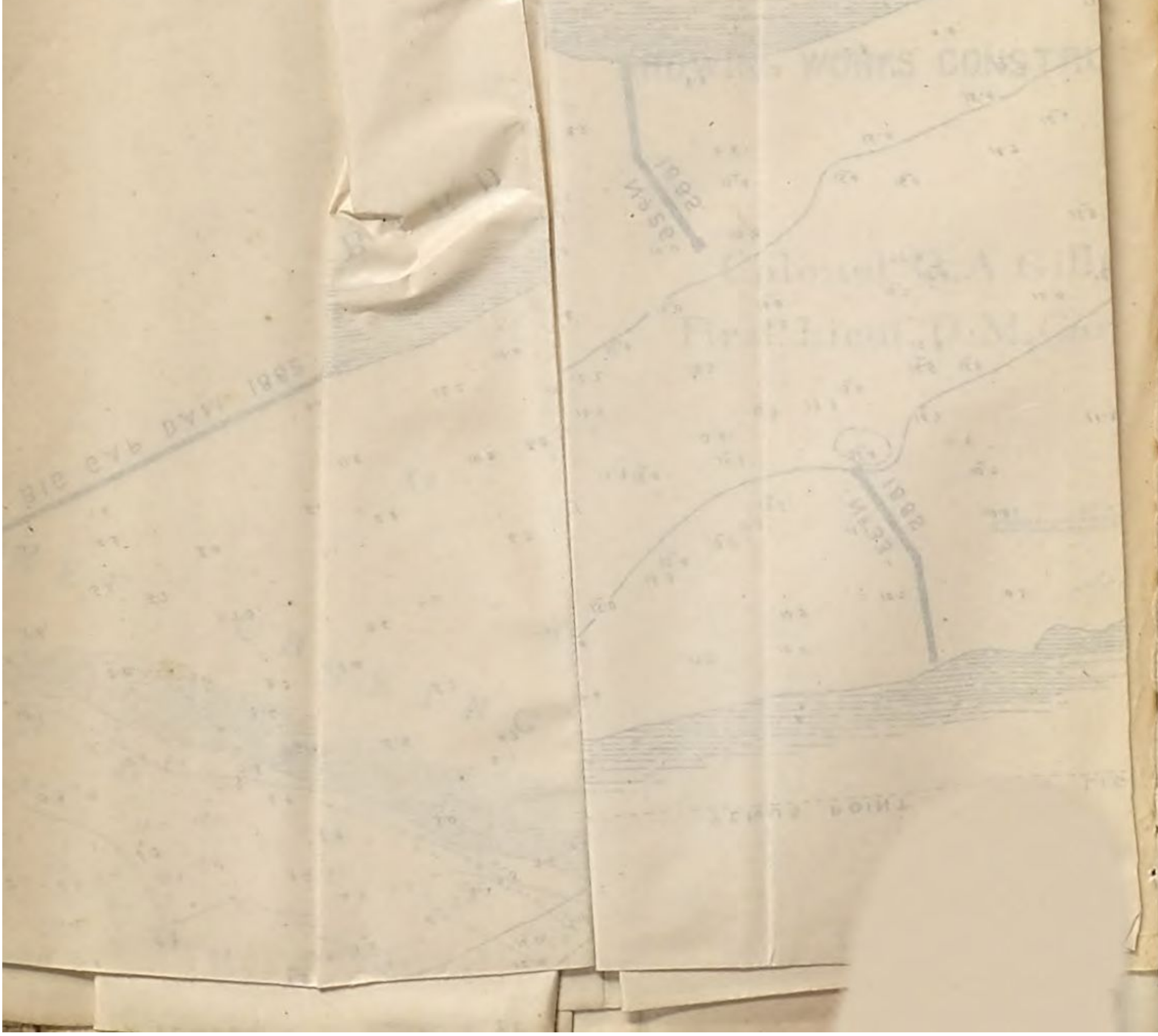
I have no new information to furnish in relation to the amount of commerce and navigation that will be benefited by completing the existing project of improvement. The importance of the work has moreover been recognized by Congress by the several appropriations made for it. I beg leave to invite attention to the remarks made on the subject in my Annual Report of 1881, and to the letter of the mayor of the city of Savannah, transmitted with my Annual Report of 1882.

This work is located in the collection district of Savannah, at the port of entry. Amount of duties collected in 1884, $49,147.28.

Since the works of improvement were commenced, the following appropriations have been made:

By act of Congress, approved June 23, 1874	$50,000
By act of Congress, approved March 3, 1875	70,000
By act of Congress, approved August 14, 1876	62,000
By act of Congress, approved June 18, 1878	70,000





By act of Congress, approved March 2, 1879	$100,000
By act of Congress, approved June 14, 1880	65,000
By act of Congress, approved March 3, 1881	65,000
By act of Congress, passed August 2, 1882	200,000
By act of Congress, approved July 5, 1884	200,000
Total	882,000

Of this amount, there has been expended to June 30, 1885, including outstanding liabilities, $831,614.40.

To complete the work of improving Savannah Harbor and River, in accordance with the project dated January 16, 1882, further appropriations are required to the aggregate amount of $330,000.

The following drawings and papers are transmitted herewith:

Sheet 1.—Chart showing works constructed between Fig Island and Elba Island to June 30, 1885.

Sheet 2.—Chart showing works constructed between Elba Island and Cockspur Island to June 30, 1885.

Report of First Lieut. O. M. Carter, Corps of Engineers.

Commercial statistics of the port, furnished by the collector of customs.

Money statement.

July 1, 1884, amount available		$1,074 50
Amount appropriated by act approved July 5, 1884		200,000 00
		201,074 50
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$118,374 31	
July 1, 1885, outstanding liabilities	32,314 59	
		150,688 90
July 1, 1885, amount available		50,385 60
Amount (estimated) required for completion of existing project		330,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		330,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

Abstract of proposals for construction of training-walls and wing-dams in Savannah Harbor and River, Georgia, opened August 16, 1884.

No.	Name of bidders.	Mattresses per square yard.	Stone per cubic yard.	Aggregate cost of the work.	Date of commencing work and monthly progress.
1	Rittenhouse Moore	$1 35	$3 40	$236,750	As required by specifications.
2	William H. Browne	55	3 03	129,350	Do.
3	P. Sanford Ross	57	3 30	137,250	Do.
4	John F. Gaynor	47	3 05	119,750	Do.

Contract awarded to John F. Gaynor at the price stated.

Abstract of proposals for dredging in Savannah Harbor, Georgia, opened October 17, 1884.

No.	Names of bidders.	In Harbor and river, per cubic yard.	In Burden Channel, per cubic yard.	Date of commencing work, and monthly progress.
1	Jacob Paulsen	$0 19	$0 49	On award of contract; 12,000 yards per month.
2	American Dredging Company	24	.....	December 25, 1884; completed June 30, 1885.

Proposals rejected, the prices being considered too high.

Abstract of proposals for dredging in Savannah Harbor, Georgia, opened November 17, 1884.

No.	Names of bidders.	From Cross Tides to lower end of Lower Flats, per cubic yard.	From lower end of Lower Flats to Fort Pulaski, per cubic yard.	In Burden Channel, northeast of Fort Pulaski, per cubic yard.	Date of commencing.
1	Jacob Paulsen.....	$0 18	$0 22	$0 49	December 17, 1884.
2	P. Sanford Ross.....	17¾	17¾	90	December 17, 1884.

Contract awarded to P. Sanford Ross at the prices stated for sections from Cross Tides to Fort Pulaski. Proposals for work in Burden Channel rejected, the prices being deemed too high.

REPORT OF LIEUTENANT O. M. CARTER, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Savannah, Ga., July 3, 1885.

COLONEL: I have the honor to submit the following report of operations for improving the harbor at Savannah, Ga., during the fiscal year ending June 30, 1885:

The work has consisted in constructing wing-dams of log and brush mattresses ballasted with riprap stone, and in dredging, the operations having been carried on in accordance with the plan described in your report of January 16, 1882. In raising and repairing old dams, where the use of the ordinary log mattress was found to be disadvantageous, brush fascines were used. The stone, mattress, and brush work was done under contract with John F. Gaynor, of Fayetteville, N. Y. The contract for dredging was awarded to P. Sanford Ross, of Jersey City, N. J., but as he failed to begin work at the proper time, and as dredging was urgently needed, authority was asked and obtained to put in another dredge at the contract price, for a time equal to the delay of the contractor; 67,542.75 cubic yards were removed under this authority by Jacob Paulsen, of Savannah, Ga. The contractor's dredge began work on April 29. On the 30th of May dredging was suspended. It will be resumed later in the season. The existing dams were instrumentally examined during the month of June, to determine their present condition, and to ascertain the effects produced by them. The adjacent channels were carefully sounded during the same month.

CROSS TIDES DAM.

The crest of the southern half of this dam at the close of the last fiscal year was at about mean low water, while that of the northern half was from 3 to 7 feet below that level. The overpour on the ebb had scoured out a pocket below the dam, which was in places more than 43 feet deep at mean low water. To prevent further scour and to secure an increased flow of water in Front River the dam was raised and an apron, of log mattresses from 40 feet to 70 feet in width, was sunk close against its down-stream face. Some of these mattresses were successfully set by the ordinary methods in nearly 50 feet of water. The dam was raised by building above or on the up-stream side of the old crest. The log mattresses used did not fit the irregularities of the old work well, and considerable settlement ensued. After the dam had stood long enough to approximately reach its limit of settlement the gaps were filled with brush fascines loaded with heavy blocks of stone. This work was done in June, and the crest of the dam was in this manner brought up to mean high water. There is a difference of about 2.7 feet in the low-water levels above and below the dam.

UPPER RICE MILL.

Three thousand nine hundred and eight cubic yards were dredged from a small shoal near the foot of West Broad street. The shoal no longer exists, and the width of channel 22 feet deep at mean high water is now nowhere less than 100 feet.

GARDEN BANK SHOAL.

Wing-dams Nos. 1, 2, and 3, built for the improvement of this shoal, are in good condition. They show no signs of settlement. The width of the 12-foot mean low-water channel has not diminished since last year's report. Some shoaling occurred dur-

ing the year opposite the entrance of a discharge pipe from the gas works, and 5,547.5 cubic yards were dredged from the channel in this vicinity. The least mean high-water sounding over this shoal is now 20 feet.

MECK'S CHANNEL.

At the close of the last fiscal year the Fig Island Jetty, where it crosses the old ship-channel, was about 3 feet below mean low water. At various other points in this vicinity considerable settlement had taken place.

In the middle portion, where no settlement was shown, an artificial bank, covered with marsh grass, was forming.

During the month of June about two-thirds of the jetty was brought up with brush fascines to 5 feet above mean low water. The remaining portion will be brought to the same height. The fascines completely stopped the flow of water through the jetty, and within a few days after being laid the brush was found to be covered with a deposit of silt from 1 to 3 inches in thickness. The filling in along the jetty is rapidly going on, and the growth of marsh grass has extended more than 1,000 feet during the year; 39,764.95 cubic yards were dredged from the channel.

The upper and lower portions of the channel have deepened during the year from 1 to 2 feet, while the middle portion has deepened in some places more than 5 feet. The least mean high-water sounding is 20.1 feet; the greatest is 25.6 feet.

OBSTRUCTIONS.

No work has been done here during the year. Wing-dam No. 15 is in good condition.

The 15-foot mean low-water pools above and below this point are separated from each other by a distance of about 300 feet. The least mean high-water sounding across this shoal is 19.8 feet, showing little or no change during the year. A navigable channel of over 20 feet exists.

Occasional dredging will doubtless be required at this point until the south channel is closed.

UPPER FLATS.

Wing-dams Nos. 4 and 23 have not changed since last year's report. Nos. 6 and 25 have settled in a few places from 3 to 6 feet. The channel between these dams has continued to improve during the year. Its width, for a depth of 22 feet at mean high water, is nowhere less than 350 feet.

Wing-dams Nos. 10 and 27 were built in October and November to complete the work of improvement on this crossing, and in February and March 21,368 cubic yards were dredged from between these dams to aid and direct the scour to be produced by them. No. 10 shows no sign of settlement. No. 27 has settled 1 or 2 feet in several places. The inner end of this dam is not connected with the shore, but rests on Horse Shoe Shoal at a point about opposite the old entrance to Mud River. No scour has taken place at the inner end of this dam, and that portion of the river between it and the shore is rapidly silting up.

All of the shoals at the Upper Flats crossing are now removed. Before the construction of dams 10 and 27 18.5 feet could not be taken through at mean high water. At present the least sounding on the range is 22.1 feet. The width of channel 22 feet deep at mean high water is nowhere less than 100 feet. As this is found midway between the dams, it is reasonable to expect that the channel will both widen and deepen.

CABBAGE TREE CROSSING.

The bottom courses of wing-dams Nos. 14 and 29 were laid in 1883. These dams were completed last January. They have shown no settlement. No. 13 remains unfinished. Since the completion of Nos. 14 and 29 the 15-foot mean low-water curves have approached each other by scour alone more than 2,000 feet, leaving a distance of only 1,000 feet to overcome to join these curves and give the desired depth over the entire crossing. There is now a channel over 200 feet wide and nowhere less than 20.5 feet deep at mean high water. Before any work was done this depth was less than 17 feet

LONG ISLAND CROSSING.

For the improvement of this crossing wing-dams Nos. 26 and 33 were constructed. They reduce the width of the river from 3,100 to 1,300 feet. Although these dams have not materially changed since their completion in May, they have settled in a few places from 4 to 6 feet.

Before their construction 20 feet could not be carried over the crossing at mean high water. At present there is a 22-foot channel not less than 300 feet wide. Between the dams its width is more than 1,000 feet. This improvement has been effected by scour alone.

OYSTER-BED SHOAL.

Dam No. 31 was begun in May and work upon it is still in progress. The crest of the northern half of the dam is at present at about mean low water, that of the southern half from 3 to 6 feet lower.

The shoal near spar buoy No. 11 has been removed. A cut 265 feet wide and 15 feet deep at mean low water was made, connecting the deep-water pockets above and below the shoal and easing off the sharp turn formerly existing at that point. There is now a channel 22 feet deep at mean high water and not less than 400 feet wide. Before work was begun there was less than 20.5 feet of water.

MISCELLANEOUS.

The Big Gap Dam has settled near its eastern extremity to 2 or 3 feet below mean low water. Philbrick's Cut Dam has settled at its southern end about the same amount. The other closing dams on the river are in good condition and show no signs of settlement.

The river is now in much better condition than it has ever before been.

Charts of the river from Fig Island to Elba Island and from Elba Island to Cockspur Island accompany this report.

The following tables exhibit the work done during fiscal year just closed:

JETTY WORK.

Date.	Mattresses.	Fascines.	Stone.
1884.	*Square yds.*	*Cubic yds.*	*Cubic yds.*
October	2,774.16	.....	445.86
November	12,083.61	.....	2,883.99
December	10,741.63	.....	2,404.35
1885.			
January	10,871.31	.....	2,935.08
February	10,565.35	.....	2,438.40
March	14,086.86	.....	2,507.32
April	12,695.39	.....	2,479.16
May	17,548.77	1,708.44	2,405.07
June	13,728.78	3,926.05	2,703.71
Total	105,095.86	5,634.49	21,202.94

DREDGING.

Locality.	Date.	Cubic yards.
	1885.	
Upper Rice Mill	February	3,908.00
Garden Bank	January and February	5,547.50
Wrecks Channel	March, April, and May	39,764.95
Upper Flats	February and March	21,368.00
Oyster Bed Shoals	February, March, and April	27,525.75
Total		98,114.20

Especial mention deserves to be made of the faithful and efficient services rendered by the assistants connected with this office.

Very respectfully, your obedient servant,

O. M. CARTER,
First Lieut., Corps of Engineers.

Col. Q. A. GILLMORE,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

Arrivals and clearances of vessels, and commerce at Savannah, Ga., from January 1, 1878, *to December* 31, 1884.

ARRIVED.

Years.	Coastwise.			Foreign ports.						Total.		
				American vessels.			Foreign vessels.					
	Vessels.	Tonnage.	Crew.	Vessels.	Tonnage.	Crew.	Vessels.	Tonnage.	Crew.	Vessels.	Tonnage.	Crew.
1878	322	385, 532	10, 688	61	45, 208	1, 576	326	235, 787	5, 814	709	666, 527	18, 078
1879	319	411, 794	8, 235	30	21, 994	439	279	198. 040	3, 960	628	631, 788	12, 634
1880	338	446, 881	9, 996	14	7, 724	170	244	172, 224	3, 533	596	626, 829	13, 699
1881	383	508, 422	11, 069	21	10, 729	237	254	151, 463	3, 474	658	670, 614	14, 780
1882	391	544, 448	12, 605	11	4, 865	106	204	115, 061	2, 718	606	664, 374	16, 429
1883	380	468, 226	10, 659	10	4, 115	90	160	87, 025	1, 965	550	559, 366	12, 714
1884	388	482, 917	13, 735	14	5, 632	116	287	174, 676	3, 984	689	663, 225	17, 835

CLEARED.

1878	378	418, 958	10, 475	64	40, 128	1, 255	260	183, 757	5, 375	702	642, 843	17, 005
1879	365	442. 734	8, 834	36	24, 891	497	223	156, 470	3, 129	624	623, 095	12, 460
1880	310	434, 864	10, 108	26	12, 536	271	242	168, 255	3, 446	578	615, 655	13, 825
1881	369	508, 422	11, 458	22	13, 052	253	261	180. 579	3, 745	644	702, 053	15, 456
1882	350	506, 213	11, 917	23	9, 155	205	209	135, 375	3, 023	582	650, 643	15. 145
1883	355	415. 720	9, 780	10	4, 115	90	165	87, 400	2, 015	530	507, 235	11, 885
1884	360	452, 802	13, 363	15	5, 634	131	288	194, 075	4, 315	663	652, 511	17, 809

COMMERCE.

Years.	Value of exports.	Value of imports.	Duties collected.
1878	$24, 014, 625 00	$505, 596 00	$23, 364 35
1879	22, 556, 755 00	378, 782 00	27, 778 73
1880	26, 129, 896 00	660, 974 00	78, 458 41
1881. Foreign and coastwise	47, 448, 117 00	952, 512 00	356, 550 22
1882. Foreign and coastwise	48, 349, 033 00	657, 255 00	61, 148 70
1883	50, 890, 937 00	567, 182 00	65, 245 34
1884	50, 934, 184 00	696, 434 00	49, 147 28

T. F. JOHNSON,
Collector.

N 7.

IMPROVEMENT OF SAVANNAH RIVER BETWEEN THE CITIES OF AUGUSTA AND SAVANNAH, GEORGIA.

Operations for improving Savannah River between the cities of Augusta and Savannah have been carried on with intermission since 1881 by means of three appropriations, aggregating $55,000.

An examination of this portion of Savannah River was made under my direction in September and October, 1880, a report of which, dated December 22, 1880, with plan of improvement, appears in Appendix J 6, Annual Report of the Chief of Engineers for 1881, and is printed in House Ex. Doc. No. 23, Forty-sixth Congress, third session.

The distance between the cities of Augusta and Savannah is estimated at 108 miles in a straight line and at 248 miles by river.

For a greater part of the year the river was found to be navigable for steamboats drawing from 4 to 5 feet, but during the dry season in autumn the river is very low at various places, and boats had then to discharge and receive their cargoes at some point below Augusta.

The chief obstructions to navigation were found to comprise shoals or bars of sand, snags, floating and overhanging trees, and pile obstructions.

PROJECT OF IMPROVEMENT.

The project for improving the river recommended in my report of December 22, 1880, comprises the following works:

(1) Narrowing the river by low wing-dams where excessive widths produce or maintain bars.

(2) Aiding the accumulation of silt between the wing-dams by light hurdle traverses.

(3) Protecting the banks where needed by thin flexible brush-mattresses, weighted with stone, or in some other suitable manner.

(4) Cutting off projecting points of land.

(5) Removing existing pile obstructions.

(6) Removing snags, floating timber, and overhanging trees.

(7) Aiding the formation of the low-water channel in a few localities by dredging.

The object of the plan of improvement is to procure a low-river channel of not less than 5 feet, and the cost of the works is estimated at $91,000.

OPERATIONS PRIOR TO JUNE 30, 1884.

In accordance with the project a snag-boat was constructed to remove obstructions from the river. A part of the cost of building and equipping the boat was paid from an appropriation for improving Altamaha River, Georgia.

At Gardner's Bar, opposite the lower part of the city of Augusta, five wing-dams were built, extending a length of about 2,000 feet along the left or South Carolina bank. They reduce the width of the river, originally averaging 650 feet, to 350 feet.

At Course's Bar, 1 mile lower down, one wing-dam was built and the foundation courses of two other dams laid, with their shore ends on the left bank of the river.

The right or Georgia bank just below Gardner's Bar is high and abrupt, and had been caving for many years at an average rate of 1½ feet per annum. Eight prominent points of this bank received revetments aggregating 1,375 linear feet and protecting 3,200 feet of the bank.

The United States snag-boat Toccoa operated at a number of places on the river above the city of Savannah and removed 182 snags, 51 piles, 151 leaning trees, and several wrecks of flat-boats.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1885.

Operations during the past fiscal year were carried on by means of the appropriation of $15,000 made by the act approved July 5, 1884.

The snag-boat was employed part of the year in removing snags, trees, and other obstructions.

Work on wing-dams and bank protection was done at Course's Bar, Sand-Bar-Ferry Bar, and Blue House Bar, 2, 4, and 6 miles, respect-

ively, below the city of Augusta. The wing-dams at the bars named were built by contract. As the methods of construction of both dams and shore protections differed somewhat from those previously employed, the following extract from the specification is given:

The dams will consist of brush made into fascines and loaded with stone or stone and gravel. The fascines may, at the option of the engineer in charge, be laid one at a time or in mats, except where the water is over 4 feet deep, when they must be made into mats. When laid in shoal water, or when required by the engineer in charge, the fascines will be fastened by stakes. There shall be, when stakes are used, at least two stakes for each fascine, or for each foot in length of mat. These stakes shall be at least 5 feet long for bottom layers, and 6 feet long for the upper layers, should any be laid, and they must be driven until their heads are level with the brush.

When only one layer of fascines is laid the covering of stone may be from 6 to 10 inches thick.

When more than one layer of facines is used each layer, except the top one, shall be covered with stone or coarse gravel, or a mixture of both, from 4 to 6 inches in thickness.

The second layer of brush shall be laid from 5 to 8 feet (as may be required) farther up-stream than the lower layer, and this second layer shall be fastened and covered as the lower; and additional layers shall be similarly placed and covered, except that they shall be placed and laid each about 2 feet further up-stream than the one immediately below it, and the top layer covered with stone, as described above, where a single layer of brush is used.

In general, the volume of the stone in a dam after it shall become compacted should not exceed one-half to two-thirds the volume of the fascines. Where coarse gravel is used it may be necessary to apply it more liberally.

The amount of stone or gravel to be used and the manner of distributing it will be prescribed by the engineer in charge.

At the juncture of each dam with the shore there will be built 100 to 150 feet of shore protection, 25 to 50 feet above and 75 to 100 feet below the center line of the dam.

These shore projections will consist of a layer of fascines or loose brush, as may be required, made into mats sunk at the foot of the slope of the bank, extending out into the river and up the slope as far as may be necessary, and riprap stone will be distributed over said mat in such manner and in such quantity as will be designated by the engineer in charge.

Similar shore protections may also be required at other points of the banks, in the section of the river indicated in these specifications, and will be constructed wherever required by the engineer in charge.

The bank will be trimmed to a regular slope, and all trees, stumps, &c., removed before the building of the shore protection, and no extra charge for such preparation of the bank will be allowed.

Fascines shall be made of live brush, well trimmed and closely choked, 15 feet long, and from 12 to 15 inches in diameter at the butt, and tied with four bands of tarred rope, the bands to be placed as the engineer in charge shall approve. When made into mats they will be closely packed and secured by at least three pairs of binding poles, joined by ties of tarred rope not more than 2 feet apart. The form of the fascines will be slightly tapering, and when made into mats the butts will be side by side.

Mats must be from 12 to 15 inches thick at the butt ends of the fascines, and not less than 15 feet wide.

The stone must be of a kind that will not disintegrate upon exposure to the atmosphere or water. Its minimum size for top covering and shore projections must be equivalent to 6-inch cubes, but when used between layers of brush it may be as small as coarse gravel, and not larger than a 6-inch cube or its equivalent. In general gravel will not be used except between mats.

For measurement, the stone, gravel, and fascines will be piled up in square piles, either on shore or on a boat, where they can be accurately measured. The broken stone must weigh not less than 2,700 pounds to the cubic yard.

Mr. Edward H. Gaynor was the lowest of four bidders for the work Operations under his contract were commenced April 19, 1885, and concluded June 30, 1885.

At Course's Bar two wing-dams, the foundations of which had already been laid, were completed, and two additional dams built.

At Sand-Bar-Ferry Bar, four wing-dams were built on the South Carolina side of the river, and one dam on the Georgia side, with the

necessary shore protections, all above the ferry landing, to increase the depth of water on the shoal where the channel crosses from one side of the river to the other.

Two pairs of wing-dams were built at Blue House Bar, reducing the width of the river, formerly about 650 feet, to 400 feet; 4,916 cubic yards of fascines and 1,863 cubic yards of stone were used in these several works.

The operations of the United States snag-boat Toccoa extended from July 18, 1884, to January 28, 1885, with several interruptions on account of the high stages of water. The greater part of the work was done on the reach from Cooney Gut Bar, 8 miles below Augusta, to Brigham Bar, 62 miles lower down. Nothing had ever been done here previously. The channel was also cleared of obstructions on the 19-mile reach from Brigham Bar to the lower mouth of King Creek Cut.

The operations comprised the removal of 358 snags, 11 large cypress stumps, 3 piles, 385 overhanging trees, and the wreck of a flat-boat.

The dams built under the last contract are of too recent construction to have produced any considerable effects. With the exception of these localities and of some other bars, the improvement of which is provided for in the existing project, the river is now in fair condition for low-water navigation from Augusta down to King Creek Cut-off, a distance of 118 miles. Some work, however, remains to be done by the snag-boat at a few points above King Creek, and also between that place and Savannah, a distance of 165 miles.

No operations are contemplated during the present year unless funds are provided at an early day of the next session of Congress.

The Savannah River from Augusta to Savannah forms a convenient and economical transportation route for agricultural products and merchandise, and by securing a better low-river depth in the channel of navigation large tracts of country on both sides of the river and above Augusta will be materially benefited. It is desirable that a sufficient appropriation should be made by Congress to complete the existing project.

This work is located in the collection district of Savannah, Ga. Savannah is the nearest port of entry. Amount of duties collected in 1884, $49,147.28.

Since the plan of improvement was adopted the following appropriations have been made:

By act of Congress approved March 3, 1881	$15,000
By act of Congress passed August 2, 1882	25,000
By act of Congress approved July 5, 1884	15,000
	55,000
Received from other appropriations for use of snag-boat	2,500
Total	57,500

Of this amount the sum of $56,985.83 had been expended to June 30, 1885.

The total cost of the existing project was estimated at $91,000. I am not now prepared to say that this amount will carry the work to completion. The improvement, however, as far as it goes, will extend over all the bad navigation, so as to utilize all the work done as far as possible.

The following drawings and papers are transmitted herewith:

Chart of Savannah River from Augusta to Savannah, compiled from Mill's Atlas, with corrected distances. In two sheets.

SAVANNAH RIVER GA.

SHEET I

SHOWING OPERATIONS OF U.S. SNAG BOAT TOCCOA

FROM

Augusta Ga. to Saxons Landing Ga.

UNDER THE DIRECTION OF

Colonel Q.A. Gillmore, Corps of Engineers, Brt. Maj. Genl U.S.A.

First Lieut. O.M. Carter, Corps of Engineers U.S.A. in local charge

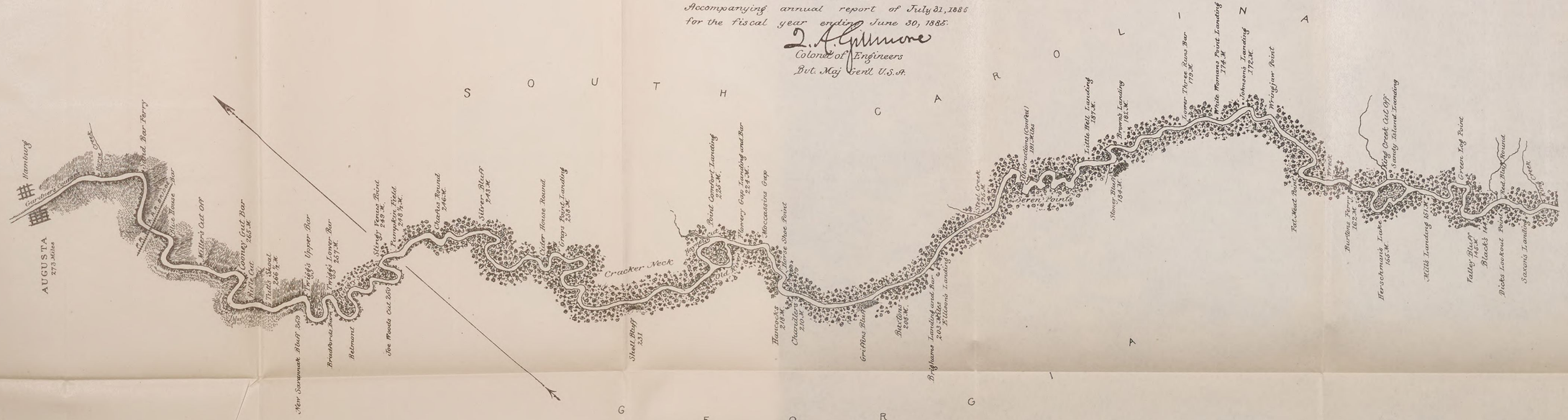
John. H. Westerfield Assistant Engineer

SCALE OF MILES

1 3/4 7/4 1/4 0 1 2 3 4 5

Accompanying annual report of July 31, 1885
for the fiscal year ending June 30, 1885.

Q. A. Gillmore
Colonel of Engineers
Brt. Maj Genl U.S.A.



LEGEND

This chart of Savannah River Ga. is based on Mills Atlas of South Carolina

Its scale is only approximately true

The local names and distances from Savannah, are given by John H. Westerfield, Asst. Engr, and are correct.

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SAVANNAH RIVER GA.

SHEET II

SHOWING OPERATIONS OF U.S. SNAG BOAT TOCCOA

FROM

Saxons Landing Ga. to Savannah Ga.

UNDER THE DIRECTION OF

Colonel Q.A. Gillmore, Corps of Engineers, Brt. Maj. Genl. U.S.A.

First Lieut. O.M. Carter, Corps of Engineers U.S.A. in local charge

John H Westerfield Assistant Engineer

SCALE OF MILES

0 ¼ ½ ¾ 1 2 3 4 5

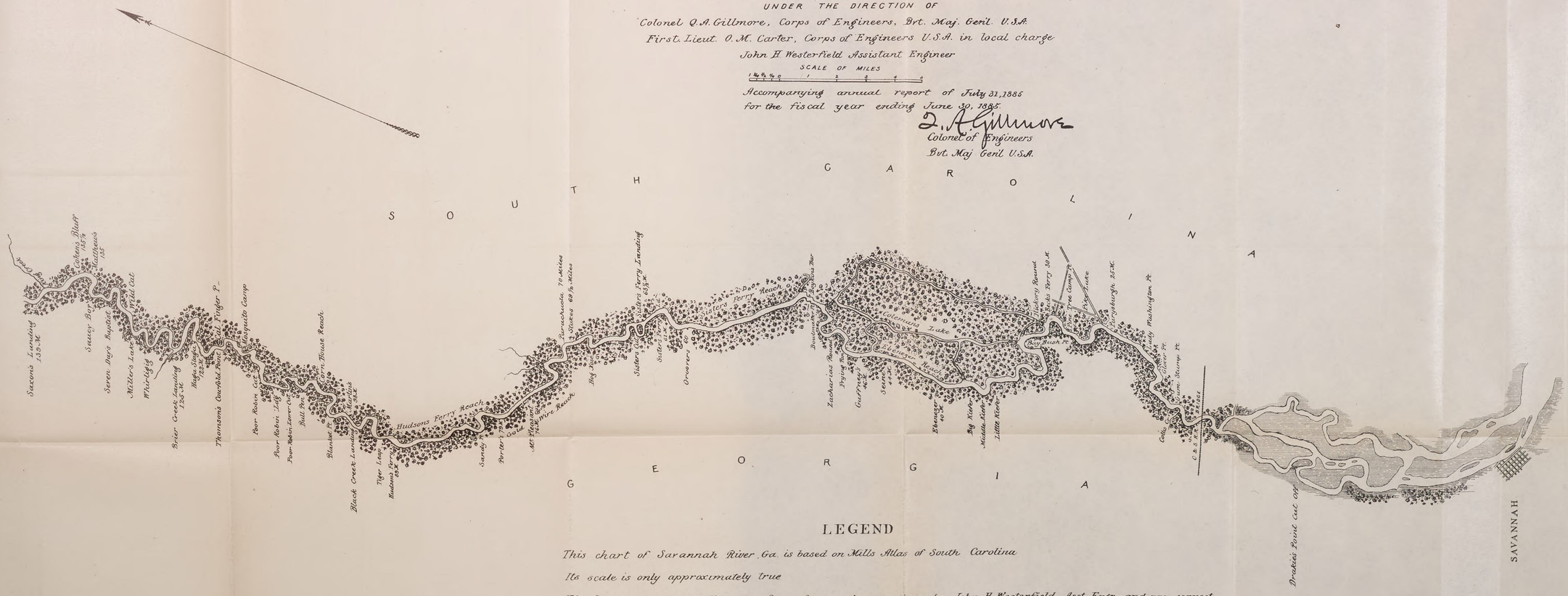
Accompanying annual report of July 31, 1885

for the fiscal year ending June 30, 1885.

Q. A. Gillmore

Colonel of Engineers

Brt. Maj Genl U.S.A.



LEGEND

This chart of Savannah River Ga. is based on Mills Atlas of South Carolina

Its scale is only approximately true

The local names and distances from Savannah, are given by John H. Westerfield Asst. Engr, and are correct

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Report of First Lieut. Frederic V. Abbot, Corps of Engineers, in local charge of work on wing-dams and shore protections.

Report of First Lieut. O. M. Carter, Corps of Engineers, in local charge of operations of snag-boat.

Money statement.

July 1, 1884, amount available		$1,044 12
Amount appropriated by act approved July 5, 1884		15,000 00
		16,044 12
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	11,824 57	
July 1, 1885, outstanding liabilities	3,705 38	
		15,529 95
July 1, 1885, amount available		514 17
Amount (estimated) required for completion of existing project		36,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		36,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

Abstract of proposals for construction of wing-dams, &c., in Savannah River, Georgia, below Augusta, opened October 17, 1884.

No.	Names of bidders.	Fascines per cubic yard.	Stone per cubic yard.	Gravel per cubic yard.	Cost on basis in specification.	Date of commencing work and monthly progress.
1	Atkins & Hoffman	$0 98	$1 95	$1 75	$6 64	Begin December 10, 1884, $2,000 per month.
2	Edward H. Gaynor	0 93	2 31	0 47	5 57	As required by specifications.
3	J. E. Walter	1 40	2 85	2 85	9 90	Do.
4	A. J. Howell	1 87	2 47	1 09	9 17	Do.

Contract awarded to Edward H. Gaynor at the prices stated.

REPORT OF LIEUTENANT FREDERIC V. ABBOT, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Charleston, S. C., July 1, 1885.

SIR: I have the honor to submit the following report of the work done for "improving Savannah River below Augusta, Ga.," for the fiscal year ending June 30, 1885:

Work has been done at three points. At Course's Bar, about 2 miles below the city of Augusta, the system of wing-dams begun under the previous appropriation has been partly completed. It is thought that enough has been done to remove the shoal at this point, but, as the work was completed only on the 30th day of June, it is not yet possible to make any definite statements as to the results obtained. As the system is not yet completed as designed, it is not improbable that more work will have to be done at this point.

At Sand-Bar-Ferry Bar, a set of wing-dams has been built to improve the crossing that occurs at this point. As the appropriation was small, only the most important dams designed for this place were built. After observing the effect of what has been done, a small amount of additional work will probably be all that will be needed at this point.

At Blue House Bar, a little further down-stream, a set of wing-dams has been constructed, which may do all that is required for the improvement of this crossing, unless the sand-bar above the work moves down the stream, in which case some more work will probably be required. The object which has been kept in view throughout in expending the appropriation has been to do the most good with the small amount

of money available, with the idea of completing the improvement of these shoals if another appropriation for this river is made.

Much credit is due Assistant Engineer R. G. Thomas, who has done most excellent work on this river.

Very respectfully, your obedient servant,

FREDERIC V. ABBOT,
First Lieut. of Engineers.

Col. Q. A. GILLMORE,
Corps of Engineers, U. S. A.

REPORT OF LIEUTENANT O. M. CARTER, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Savannah, Ga., July 7, 1885.

COLONEL: I have the honor to submit the following report of operations of the United States snag-boat Toccoa for the fiscal year ending June 30, 1885:

The boat was built under your direction in 1882, and has been employed during the past year on the Altamaha and Savannah rivers.

SAVANNAH RIVER.

Operations were begun on this river on July 18, 1884, and were suspended on January 28, 1885, the appropriation having been exhausted.

The principal work done was on the upper portion of the river, between Cooney Gut Bar and Brigham's Bar, a distance of 62 miles. No work had ever been done here, and the river was so obstructed as to be practically impassable at low stages. A great deal of work was also done between Brigham's Bar and the lower mouth of King Creek Cut-off. White Woman's Point on this reach had been for some time the upper limit of low-water steamboat navigation, the channel being completely blocked with logs and snags. These have been removed, and there is now at this point a good channel over 100 feet wide and 6½ feet deep at low water. On the 27th of November the river began to rise, and the only work possible from that date until the close of operations was the removal of dangerous overhanging trees.

The following work was done during the year:

Snags removed	358
Cypress stumps removed	11
Wreck (of flat) removed	1
Piles removed	3
Overhanging trees removed	385

One hundred and seventy-five and a half pounds of Hercules powder number one was used in cutting off stumps, logs, and snags that could not be removed with the snag-boat hoisting apparatus alone. With the exception of sand-bars at Cooney Gut, Tutt's Shoal, Flowery Gap, and Brigham's Landing, the river is in fair condition from Augusta to King Creek Cut-off. Some little work with the snag-boat will be required at Hungry Swamp and Seven Points. The lower portion of the river needs attention.

Charts of the Savannah River from Augusta to Saxon's Landing and from Saxon's Landing to Savannah, compiled from Mills's Atlas of South Carolina, accompany this report. While not strictly accurate, they are valuable, and give a very good idea of the river.

During the month of February the boat was undergoing repairs. She was thoroughly overhauled in every part, and is now in first-rate condition.

Mr. John H. Westerfield has been the assistant engineer in immediate charge of the snag-boat during the year. His services have been characterized by marked efficiency.

Very respectfully, your obedient servant,

O. M. CARTER,
First Lieut., Corps of Engineers.

Col. Q. A. GILLMORE,
Corps of Engineers, U.S. A.

N 8.

IMPROVEMENT OF SAVANNAH RIVER ABOVE AUGUSTA, GEORGIA.

Three appropriations, aggregating $39,000, have been made by Congress since 1880 for improving Savannah River between the city of Augusta, Ga., and Trotter's Shoal, 64 miles above.

The river was examined under my direction from Augusta up to the head of pole-boat navigation, near Tallulah Falls, a length of 154 miles, in November and December 1878. My report thereon, dated February 8, 1879, is printed in Appendix I 2, Annual Report of the Chief of Engineers for 1879. I stated in the report that until a thorough examination could be made above Trotter's Shoal any money that might be appropriated should be expended upon that portion of the river below said shoal.

Two estimates were submitted, viz:

(1) Cost of improving the river for pole-boat channel, 3 feet by 30 feet, Augusta to Trotter's Shoal, 64 miles	$45,000
(2) Cost of steamboat channel, 30 feet by 90 feet, same route	125,000

Operations have been carried on in conformity to the first-named project.

The obstructions to be removed under the adopted project are numerous, and consist chiefly of rocky ledges running across the channels, isolated bowlders of various sizes, and shoals of gravel.

OPERATIONS PRIOR TO JULY 1, 1884.

The river was more or less improved at many places within the section embraced in the project, especially in the lower reach.

From the canal lock, 7 miles above Augusta, to Barksdale, 50 miles from the city, a channel was secured through the obstructions 20 feet wide and 2½ deep at summer low water. The work consisted in removing solid ledge-rock, bowlders, and gravel, and in building wing dams for contracting the water-way, the dams being constructed either entirely of broken stone or of brush mattresses and stone combined; 4,094 cubic yards of ledge-rock, 37 cubic yards of bowlders, and 62 cubic yards of gravel were removed.

For building the dams nearly 6,670 square yards of brush mattresses and 4,183 cubic yards of broken stone were used.

No operations were carried on during the past fiscal year, as the balance of funds on hand July 1, 1884, was too small to do work to any advantage, and no further appropriation had been made to continue the improvement.

As to the amount of commerce and navigation to be benefited by completing this improvement, I beg leave to refer to my report of February 8, 1879. No additional data have been received since that time.

An examination quite recently made has shown that where the channel was deepened and widened by blasting of rock the river has been much improved. Some of the dams put in for the removal of sand-bars have proved effective, but in many cases they appear to have failed, as the works were not sufficiently extensive to produce the desired results.

This work is located in the collection district of Savannah, Ga., which is the nearest port of entry. Amount of duties collected in 1884, $49,147.28.

Since the work of improvement was commenced the following appropriations have been made:

By act of Congress approved June 14, 1880	$16,000
By act of Congress approved March 3, 1881	8,000
By act of Congress passed August 2, 1882	15,000
Total	39,000

Of this amount there has been expended from the beginning of operations to June 30, 1885, the sum of $38,122.94.

Money statement.

July 1, 1884, amount available	$877 06
July 1, 1885, amount available	877 06
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	6,000 00

REPORT OF LIEUTENANT FREDERIC V. ABBOT, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Charleston, S. C., July 1, 1885.

COLONEL: I have the honor to submit the following report of work done during the past fiscal year for improving Savannah River above Augusta, Ga.

No work has been done during the last fiscal year. An examination made in 1885 shows that where blasting out of rock was done the river has been much improved. Some of the dams put in for the removal of sand-bars have proved effective, but in many cases no good seems to have been done, as the works were not sufficiently extensive to produce the desired results.

Respectfully submitted.

FREDERIC V. ABBOT,
First Lieut. of Engineers.

Col. Q. A. GILLMORE,
Corps of Engineers, U. S. A.

N 9.

IMPROVEMENT OF SAINT AUGUSTINE CREEK (THUNDERBOLT RIVER), GEORGIA.

Of the sum of $5,000 appropriated by act of Congress approved March 3, 1879, $1,582.34 were expended during the fiscal year ending June 30, 1881, in the partial removal of the wreck of a large timber dry-dock which was sunk in the middle of the stream during the late civil war.

There appears to be no necessity for any further improvement of the river at this point, and no appropriation is asked.

This work is located in the collection district of Savannah. Savannah is the nearest port of entry. Amount of import duties collected in 1884, $49,147.28.

Money statement.

July 1, 1884, amount available	$3,417 66
July 1, 1885, amount available	3,417 66

N 10.

IMPROVEMENT OF ROMERLY MARSH, GEORGIA.

Two appropriations, aggregating $20,000, have thus far been made by Congress for improving Romerly Marsh, Georgia, "by the route designated in the survey of the engineers as route numbered four." The sum of $5,000 was contributed in 1883 for facilitating the work by the Georgia and Florida Steamboat Company under conditions stated in my annual report of that year and approved by the Department.

The water-route through Romerly Marsh forms a part of the inland passage between the Savannah River, Georgia, and the Saint John's River, Florida. Romerly Marsh is situated to the southeast of Skidiway Island, between Wassaw Sound on the north and Ossabaw Sound on the south.

My report, dated November 15, 1880, of an examination of Romerly Marsh, made under my direction in the latter part of the year 1880, contains descriptions of four different routes that might be selected for improvement, with estimate of cost of each. The report is printed as Appendix J 19 of the Annual Report of the Chief of Engineers for 1881, and in House Ex. Doc. No. 19, Forty-sixth Congress, third session.

PROJECT OF IMPROVEMENT.

Route number four, named in the act of Congress, is the most easterly one of those that were examined. By this route the northerly creek, known as Dead Man's Hammock Creek, which flows through the marsh and empties into Wassaw Sound near the mouth of Romerly Marsh Creek, is to be connected by a cut with Wassaw Creek, which flows into Odingsell River not far from the point where the latter empties into Ossabaw Sound. The mean rise and fall of the tides is here about 7 feet.

By this route the existing passage through Romerly Marsh, which is exceedingly crooked, with sharp bends and insufficient low-water depths, will be avoided, and replaced by one which can be navigated with much greater convenience, although it will be over 2 miles longer.

It is proposed that the new route shall have not less than 7 feet depth at mean low tide, with a minimum bottom width of 48 feet, and side slopes of one height to three base, or steeper, if practicable. The length of the cut through the marsh will be 1,156 yards.

The cost of the project is estimated at $38,720.

It may be stated that if the improvement of route numbered four had not been made mandatory by Congress that route would not have been selected. The intermittent method of prosecuting the work, for want of money, will add to its cost, as the cut can receive no benefit from the tidal scour until it has been carried entirely through; a stage not yet reached.

OPERATIONS PRIOR TO JULY 1, 1884.

Dredging operations were commenced in May, 1883, and carried on until December of the same year. During that time the cut was opened to a length of 1,650 linear feet; about half the total required length. This cut was dredged to a width of from 40 to 50 feet at bottom, with 7 feet depth below the level of low water. The width at the level of the marsh varied from 105 to 135 feet, according to the elevation of the ground above low water. Seventy-four thousand six hundred and fourteen cubic yards of material had been removed.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1885.

An appropriation of $10,000 for continuing the improvement was made by the act of Congress approved July 5, 1884. Proposals for dredging were invited in September, but none were received. Under a second call, dated November 3, 1884, two proposals were received, that of Mr. P. Sanford Ross, of Jersey City, N. J., at 21½ cents per cubic yard being the lowest. This was accepted and a contract was entered into with Mr. Ross.

Operations under the contract were commenced in March, 1885. It was found impracticable to begin extending the cut at once for the reason that during the suspension of work for fourteen months a shoaling of more than 2 feet had taken place throughout the entire length of the incomplete cut, while its low water width had diminished about 30 feet. It had, therefore, to be widened and deepened to allow the tug-boat and scows to move about. Over two-thirds of the material removed to June 30, 1885, was taken out for the purpose of restoring the depth and width originally dredged. The net advance made in extending the work to the date named was therefore but small, only 70 linear feet having been added to its former length, making its total length on June 30, 1720 feet; 26,485 cubic yards of material had, at that date, been taken out under the existing contract, making the total amount removed from the beginning of operations 101,100 yards.

OPERATIONS CONTEMPLATED DURING THE PRESENT FISCAL YEAR.

With the balance available July 1, 1885, the work of extending the cut southward toward Wassaw Creek will be continued in conformity to the existing project.

CONDITION AND EFFECTS OF THE WORK.

The cut, as far as it has progressed, is at present in good order and of the required dimensions as to width and depth, but the balance of the funds available for prosecuting the work during the first months of the present fiscal year are inadequate to complete it to its full length. After suspending operations the cut will undoubtedly again deteriorate, as there will be no currents through it and the inflowing and outflowing tides will deposit sediment and wash down the soft banks. In the case of the improvement of Romerly Marsh the inexpediency of making insufficient appropriations is especially evident, since no benefit whatever can accrue to navigation until the work is completed throughout, and a considerable portion of the funds periodically supplied must be expended in doing part of the work over again. Under these circumstances it is probable that the original estimate will be exceeded by at least $10,000

The inland passage between Savannah, Ga., and Fernandina, Fla., of which the cut now in progress is designed to form a part in place of the existing crooked and shallow passage through Romerly Marsh, is an important and valuable commercial route. Remarks on this subject were made in my annual report for 1880, to which attention is respectfully invited.

This improvement is located in the collection district of Savannah, Ga. Savannah is the nearest port of entry. Amount of duties collected in 1884, $49,147.28.

Since this improvement was commenced the following appropriations have been made:

By act of Congress passed August 2, 1882	$10,000
By act of Congress approved July 5, 1884	10,000
Total	20,000

The total expenditures from the beginning of operations to June 30, 1885, including the $5,000 contributed by the steamboat company, and outstanding liabilities, were $21,156.63.

The report of First Lieut. O. M. Carter, Corps of Engineers, is transmitted herewith.

Money statement.

July 1, 1884, amount available		$29 41
Amount appropriated by act approved July 5, 1884		10,000 00
		10,029 41
July 1, 1885, amount expended during fiscal year, exclusive of oustanding liabilities July 1, 1884	$3,851 90	
July 1, 1885, outstanding liabilities	2,334 14	
		6,186 04
July 1, 1885, amount available		3,843 37
Amount (estimated) required for completion of existing project		14,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		14,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

Abstract of proposals for dredging in Romerly Marsh, Georgia, opened November 17, 1884.

No.	Names of bidders.	Price per cubic yard.	Monthly progress.	Remarks.
			Yards.	
1	P. Sanford Ross	$0 21½	15,000	Accepted.
2	James Atkins	22½	18,000	

Contract awarded to P. Sanford Ross, at the price stated.

REPORT OF LIEUTENANT O. M. CARTER, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Savannah, Ga., July 4, 1885.

COLONEL: I have the honor to submit the following report of operations for improving Romerly Marsh, Georgia, during the fiscal year ending June 30, 1885.

The contract for dredging this cut was let to P. Sanford Ross, of Jersey City, N. J., and work was begun by him on March 30. For want of funds operations had been suspended more than fourteen months. The cut during this period shoaled an average of more than 2 feet throughout its length and its low-water width diminished 30 feet.

It was specified in the act making the appropriation that the work should be continued "on the present plan." Before advancing the old cut it was found necessary to deepen it to 7 feet at mean low water, to allow the operation of the tug and scows. Twenty thousand seven hundred and fifty-two and eighty-two hundredths cubic yards were dredged in doing this work.

The cut has been extended 70 feet into the marsh, making a total length of 1,720 feet.

The following table shows the work done during the year:

Date.	Cubic yards removed.	Cost.
March, 1885	103.50	$22 25
April, 1885	7,918.82	1,702 55
May, 1885	10,066.50	2,164 30
June, 1885	8,396.50	1,805 25
Total	26,485.32	5,694 35

Very respectfully, your obedient servant,

O. M. CARTER,
First Lieut. Corps of Engineers.

Col. Q. A. GILLMORE,
Corps of Engineers, U. S. A.

N 11.

IMPROVEMENT OF ALTAMAHA RIVER, GEORGIA.

Three appropriations, aggregating $35,000, have thus far been made by Congress for improving Altamaha River, Georgia.

The Altamaha is the most important river in Georgia lying entirely within the boundaries of that State. It is formed by the confluence of the Oconee and Ocmulgee. Its length is 155 miles, with a southeasterly course, and it empties into the Atlantic Ocean through Altamaha Sound, below the town of Darien.

The river was examined under my direction in the latter part of the year 1880. My report, dated November 27, 1880, with project of improvement, is printed in Appendix J 9, Annual Report of the Chief of Engineers for 1881, and in House Ex. Doc. No. 19, Forty-sixth Congress, third session.

The chief obstructions to the navigation of the Altamaha consist in rock ledges running nearly across the river, sand-bars, and snags.

PROJECT OF IMPROVEMENT.

The project contemplates the establishment of a steamboat channel of 80 feet width and 3 feet depth at low-river stage, the cost of which was very roughly estimated at $60,000. This will probably need to be increased, as stated in previous reports. This estimate provides for the removal of about 10,500 cubic yards of rock, of an old wreck and pile obstructions, and of several thousand snags, all in the fresh-water reaches of the river, and also for the dredging of about 8,000 cubic yards of material in the vicinity of Darien. The cost of improving localities where sand-bars occur is included in the estimate, but the latter is but roughly approximate in that respect. I said in my first report that these places should be instrumentally surveyed before a proper plan for improving them can be devised.

OPERATIONS PRIOR TO JUNE 30, 1884.

At two points of the river, known as Town Bluff and Piney Bluff, $1\frac{5}{8}$ and $19\frac{1}{2}$ miles, respectively, from the confluence of the Oconee and Ocmulgee, a channel was cut through the obstructing ledges of rock. In both localities a passage was opened of a minimum width of 100 feet, with 4 feet depth at low-river stage.

The United States snag-boat Toccoa was employed for about five months, with several interruptions, caused by high water between Darien and Ohoopee White Bluff, a distance of 115 miles, removing 323 snags, 2 piles, and 185 leaning trees.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1885.

For continuing the work of improvement an appropriation of $15,000 was made by the act approved July 5, 1884.

The operations consisted essentially in constructing a training-wall with auxiliary works for improving the crossing at Beard's Bluff, in removing obstructions by the snag-boat, and in local surveys.

Proposals were invited September 18, 1884, for building wing-dams and shore protections at Beard's Bluff and Marrowbone bars, 63 and 68 miles, respectively, below the confluence of Oconee and Ocmulgee rivers.

The following is an extract from the specifications for the work:

The dams will consist of brush made into fascines and loaded with stone or stone and gravel. The fascines may, at the option of the engineer in charge, be laid one at a time or in mats, except where the water is over 4 feet deep, when they must be made into mats. When laid in shoal water, or when required by the engineer in charge, the fascines will be fastened by stakes. There shall be, when stakes are used, at least two stakes for each fascine, or for each foot in length of mat. These stakes shall be at least 5 feet long for bottom layers, and 6 feet long for the upper layers, should any be laid, and they must be driven until their heads are level with the brush.

When only one layer of fascines is laid, the covering of stone may be from 6 to 10 inches thick.

When more than one layer of fascines is used, each layer, except the top one, shall be covered with stone or coarse gravel, or a mixture of both, from 4 to 6 inches in thickness.

The second layer of brush shall be laid from 5 to 8 feet (as may be required) further up-stream than the lower layer, and this second layer shall be fastened and covered as the lower; and additional layers shall be similarly placed and covered, except that they shall be placed and laid each about 2 feet further up-stream than the one immediately below it, and the top layer covered with stone, as described above, where a single layer of brush is used.

In general the volume of the stone in a dam after it shall have become compacted should not exceed one-half to two-thirds the volume of the fascines. Where coarse gravel is used instead of stone it may be necessary to apply it more liberally.

The quantity of stone or gravel to be used, and the manner of distributing it, will be prescribed by the engineer in charge.

At the juncture of each dam with the shore there will be built 100 to 150 feet of shore protection, 25 to 50 feet above, and 75 to 100 feet below the center line of the dam.

These shore protections will consist of a layer of fascines or loose brush, as may be required, made into mats sunk at the foot of the slope of the bank, extending out into the river and up the slope as far as may be necessary, and riprap stone will be distributed over said mats in such a manner and in such quantity as will be designated by the engineer in charge.

Similar shore protections may also be required at other points of the banks, in the section of the river indicated in these specifications, and will be constructed wherever required by the engineer in charge.

The bank will be trimmed to a regular slope, and all trees, stumps, &c., removed before the building of the shore protection, and no extra charge for such preparation of the bank will be allowed.

Fascines shall be made of live brush, well trimmed and closely choked, 15 feet long and from 12 to 15 inches in diameter at the butt, and tied with four bands of tarred rope, the bands to be placed as the engineer in charge shall approve. When made into mats they will be closely packed and secured by at least three pairs of binding poles, joined by ties of tarred rope, not more than 2 feet apart. The form of the fascines will be slightly tapering, and when made into mats the butts will be side by side.

Mats must be from 12 to 15 inches thick at the butt ends of the fascines, and not less than 15 feet wide.

The lowest of the three proposals received under the call was that of Mr. Edward H. Gaynor, with whom a contract was made.

Work under this contract was confined to improving Beard's Bluff Bar, which is formed by the abrupt widening of the river at its junction with Beard's Bluff Lake, a sheet of water about a mile in length. To concentrate the currents of the channel on the shoal, a training-wall or jetty was constructed extending down-stream from the sand-spit separating river and lake. The jetty is 1,744 feet long and is formed of two courses of fascine mattresses, 15 feet wide and from 2 to 3½ feet thick, covered on the average with 8 inches of stone and 4 inches of gravel. Two spurs, each about 30 feet long, were built on the channel side of the upper portion of the jetty. Below the down-stream end of the jetty, where the increased currents of the river strike the opposite bluffy and concave bank, 500 linear feet of shore protection formed of fascines was partly built, which, when finished, will extend from 3 feet below low-river stage to 10 feet above that line.

In constructing these several works, 3,050.85 cubic yards of fascines, 650 cubic yards of stone, and 300 cubic yards of gravel were used. Op-

erations were commenced in December, 1884, suspended February 3, 1885, on account of heavy freshets in the river, renewed May 19, 1885, and were in progress at the close of the fiscal year.

The United States snag-boat Toccoa worked Ohoopee White Bluff and Rump's Field Landing, a distance of 97 miles, and removed 32 snags and logs and 433 overhanging trees. A very low stage of river being needed for the larger part of snagging operations, the boat which draws 3½ feet of water will not be of much further use on the Altamaha. There are a number of bars in the channel which the boat cannot pass at low-river stage.

CONDITION AND EFFECTS OF THE WORK.

As results of the work thus far done it can be stated that a good channel at least 100 feet wide and 4 feet deep at low water, suitable for rafts and light-draught steamboats, now exists from Lumber City, on the Ocmulgee, to some distance below Piney Bluff, over 50 miles. The depths at the crossing of Beard's Bluff Bar, which were previously less than 2 feet, have already been increased from 1 to 2 feet. The lower reaches of the Altamaha, from Darien to Steamboat Cut, 55 miles, have been well cleared by the operations of the snag-boat. Numerous obstructions were likewise removed between Steamboat Landing and Ohoopee White Bluff, a distance of 60 miles, but some further work, which can be done only at low-river stage, is required to secure an unobstructed channel.

The improvements effected at Town Bluff, Piney Bluff, and Beard's Bluff are permanent. Some attention must be given to the channels formerly infested with snags and logs to prevent a re-formation of similar obstructions.

OPERATIONS CONTEMPLATED DURING THE PRESENT FISCAL YEAR.

With the balance available July 1, 1885, the work at Beard's Bluff Bar will be completed by adding four spurs to the training-wall, and some of the obstructions which can be reached only at low-river stage will be removed by hired labor.

I have referred in former annual reports to the importance of the Altamaha River as offering an economical and convenient route for carrying the products of the forests and rice fields of a large portion of the State of Georgia to the seaboard. From the report of my assistant, First Lieut. O. M. Carter, Corps of Engineers, it appears that the shipments of lumber from the Altamaha for the year ending June 30, 1885, amounted to 72,907,896 feet. Only one steamboat is at present plying on the river; the value of its freight is estimated at over $200,000 annually.

Considering the comparatively small cost of improving this valuable river, it is recommended that an appropriation be made to complete the project without delay.

This work is located in the collection district of Brunswick, Ga. Darien is the nearest port of entry. The total collections of the custom-house at Darien in the year 1884 were $9,688.20.

Since the existing project for improving Altamaha River was adopted the following appropriations have been made for the work:

By act of Congress approved March 3, 1881	$5,000
By act of Congress passed August 2, 1882	15,000
By act of Congress approved July 5, 1884	15,000
Total	35,000

Of this amount there has been expended to the close of the fiscal year ending June 30, 1885, including outstanding liabilities, the sum of $32,085.34.

An additional sum of $40,000 is required to be appropriated to complete the project.

The following drawing and papers are herewith transmitted:

(1) Sketch of Beard's Bluff Bar.
(2) Two reports of First Lieut. O. M. Carter, Corps of Engineers.
(3) A table of commercial statistics furnished by the collector of the port of Darien.

Money statement.

July 1, 1884, amount available		$374 75
Amount appropriated by act approved July 5, 1884		15,000 00
		15,374 75
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$9,265 00	
July 1, 1885, outstanding liabilities	3,195 09	
		12,460 09
July 1, 1885, amount available		2,914 66
Amount (estimated) required for completion of existing project		40,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		40,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

Abstract of proposals for construction of wing-dams, &c., in Altamaha River, Georgia, opened October 17, 1884.

No.	Names of bidders.	Fascines per cubic yard.	Stone per cubic yard	Gravel per cubic yard.	Cost on basis of specifications.	Date of commencing work and monthly progress.
1	Atkins & Hoffman	$1 45	$5 00	$4 75	$14 10	As required by specification.
2	Edward H. Gaynor	1 17	4 47	0 49	8 47	Do.
3	A. J. Howell	1 93	2 61	0 97	9 37	Do.

Contract awarded to Edward H. Gaynor, at the prices stated.

REPORTS OF LIEUTENANT O. M. CARTER, CORPS OF ENGINEERS.

1.

UNITED STATES ENGINEER OFFICE,
Savannah, Ga., July 11, 1885.

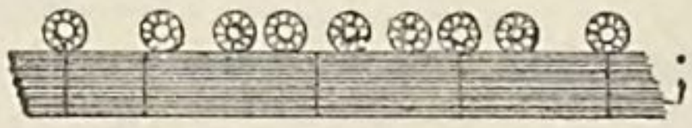
COLONEL: I have the honor to submit the following report of operations for improving Altamaha River, Georgia, during the fiscal year ending June 30, 1885. The work has consisted in the improvement in the channel over the bar at Beard's Bluff, and in the employment of the snag-boat Toccoa.

BEARD'S BLUFF BAR.

This bar is 22 miles by river from Doctortown. It is found by the abrupt widening of the river at its junction with Beard's Bluff Lake, a sheet of water about 1 mile long. The left bank of the river below the mouth of the lake is from 20 to 25 feet high. It is composed of coarse alluvial sand, and washes badly. The right bank is lower, is overflowed at every freshet, is covered with a growth of gum and cypress, and is eroded very little. The bar is formed of coarse, shifting sand. To secure the removal

of the bar by scour, a training-wall was projected to extend down-stream from the island, as shown in the sketch herewith. Some shore protection along the concave bank was also included in the project.

The contract for the work was let to Mr. Edward H. Gaynor, of Savannah, Ga., on December 5, 1884, and operations were begun by him on the 27th of the same month. The training-wall was constructed of mattresses of truss fascines loaded with 8 inches of riprap stone and 4 inches of gravel. These mattresses were 15 feet wide, of varying length, and from 2 to 3.5 feet in thickness. The fascines composing them were compacted together by three pairs of binding poles. The bottom fascines were perpendicular and the top ones parallel to the axis of the jetty.

A general cross-section of a mattress composed of two layers of fascines would be as follows:  ; the outer "catch-stone" fascines being designed to hold the loading material. A heavy freshet in the river caused the suspension of the work from February 3 to May 19. That portion of the training-wall constructed before the suspension of operations was found, upon resuming work, to have suffered no damage whatever. The jetty has been extended to a total length of 1,744.2 feet, ending in a toe 45 feet in width. Two spurs at right angles to the axes of the jetty have been constructed. Four more are to be built to prevent possible scour, and consequent undermining of the work. Five hundred linear feet of shore protection have been partially constructed. The shore protection will extend about 150 feet farther down-stream when completed. It will reach from 3 feet below extreme low water to about 10 feet above. The fascines comprising the shore protection have been well staked to the bank.

The following amount of material has been expended in bringing up the work to the close of the fiscal year:

Character of work.	Stone.	Fascines.	Gravel.
	Cubic yards.	*Cubic yards.*	*Cubic yards.*
Training-wall	605.74	2,369.70	298.85
Shore protection	44.19	681.15	.....
Total	649.93	3,050.85	298.85

A detailed survey just made shows that already, in its incomplete state, the work is beginning to develop favorable results. There is from 1 to 2 feet more water over the bar than at a corresponding stage before the training-wall was built.

The sand is filling in along the jetty and between the spurs, and the permanency of the work seems to be established.

Mr. W. B. Ross has been the efficient assistant engineer in local charge of the work during the year.

Very respectfully, your obedient servant,

O. M. CARTER,
First Lieut., Corps of Engineers.

Col. Q. A. GILLMORE,
Corps of Engineers, U. S. A.

2.

UNITED STATES ENGINEER OFFICE,
Savannah, Ga., July 7, 1885.

COLONEL: I have the honor to submit the following report of operations of the United States snag-boat Toccoa for the fiscal year ending June 30, 1885.

The boat was built under your direction in 1882, and has been employed during the past year on the Altamaha and Savannah rivers.

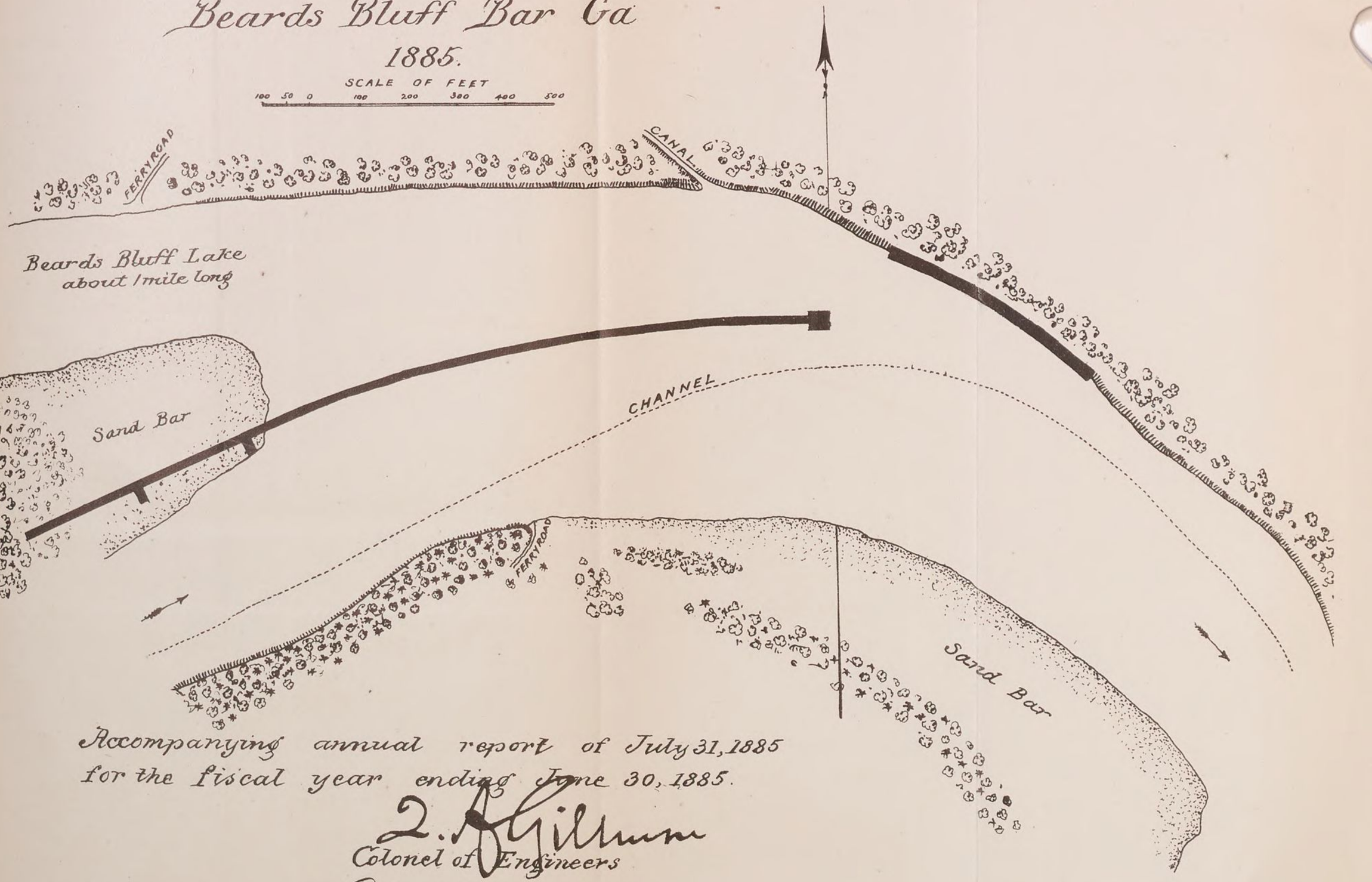
ALTAMAHA RIVER.

Operations were begun on this river on March 15 and were suspended owing to lac of funds on June 9. From April 9 to May 3 the boat was tied up, the river being

Sketch

Showing improvements at Beards Bluff Bar Ga

1885.



Accompanying annual report of July 31, 1885
for the fiscal year ending June 30, 1885.

2. A. Gillmore
Colonel of Engineers
Brt. Maj. Genl. U.S.A.

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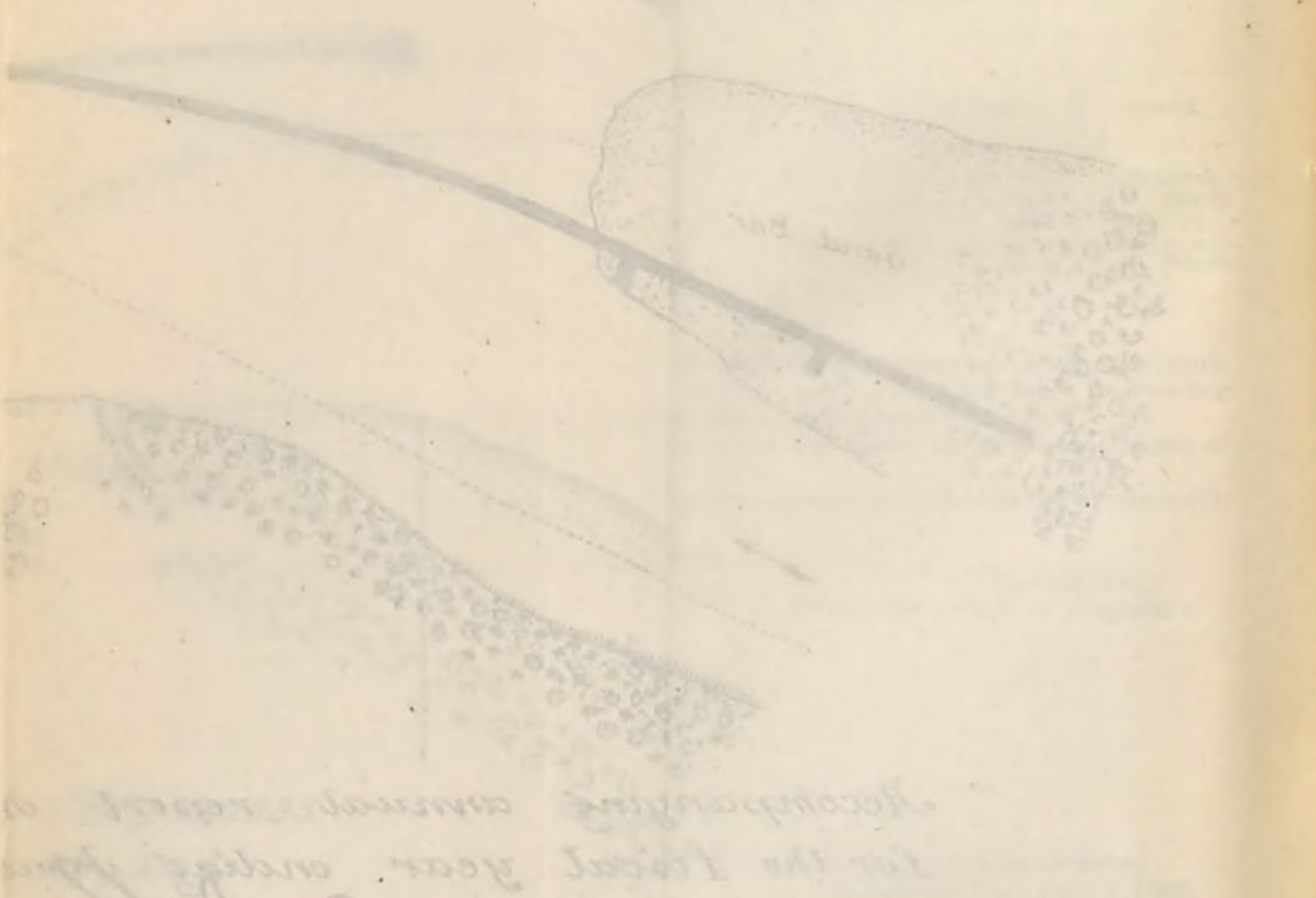


high that no work could be done. Operations were carried on between Ohoopee White Bluff and Rump's Field Landing, a distance of 97 miles. The following is a summary of the work done:

Logs and snags removed	32
Overhanging trees	433

The work of snagging has now so far advanced on this river that but little can be done towards removing obstructions to low-water navigation when the Doctortown gauge reads more than 4 feet. An extreme low stage is necessary for much work, and at this period the snag-boat's draught of water (3.5 feet) will not allow her to navigate the river. The following bars cannot be passed by the Toccoa with the gauge at Doctortown reading 3 feet (Couper Bar, at mean low water): Mornley Island Bar, bar at Miller Lake Cut-off, Oglethorpe Bluff Bar, Marrowbone Bar, and bars at Ohoopee Cut and Ohoopee White Bluff. It will be seen from the above that the stage at which the snag-boat can operate to the greatest advantage is confined to very narrow limits.

There is at present only one steamboat plying on the river. Her owner, Mr. R. L. Hicks, estimates the value of freight handled annually by his boat at $202,500.

Mr. E. C. Davis, deputy collector of the port of Darien, gives the shipments of lumber from the Altamaha River for the year ending June 30, 1885, as 72,907,896 feet. Of this amount 59,352,028 feet passed through Darien.

Very respectfully, your obedient servant,

O. M. CARTER,
First Lieut., Corps of Engineers.

Col. Q. A. GILLMORE,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

Arrivals and clearances of vessels, and commerce at Darien, Ga., from January 1, 1880, *to December* 31, 1884.

ARRIVED.

Year.	Coastwise.			Foreign ports.						Total.		
				American vessels.			Foreign vessels.					
	Vessels.	Tonnage.	Crew.	Vessels.	Tonnage.	Crew.	Vessels.	Tonnage.	Crew.	Vessels.	Tonnage.	Crew.
1880	66	21,539	489	1	668	13	134	68,072	1,608	201	90,279	2,110
1881	101	40,619	849	3	1,220	29	162	84,456	1,991	266	126,295	2,869
1882	117	48,208	999	1	453	9	90	51,421	1,155	208	100,082	2,163
1883	95	38,173	815	.....	.....	.....	93	49,790	1,135	188	87,963	1,950
1884	81	34,412	714	2	606	16	92	50,178	1,133	175	85,196	1,863

CLEARED.

1880	55	17,076	393	7	3,589	72	168	84,172	2,016	220	104,837	2,481
1881	80	28,492	617	8	3,120	70	184	95,353	2,164	272	126,965	2,851
1882	93	34,098	709	6	1,962	46	115	63,525	1,434	214	99,585	2,189
1883	66	25,019	519	9	3,533	72	108	56,411	1,340	183	84,963	1,931
1884	59	20,637	457	11	3,977	85	119	66,337	1,478	189	90,951	2,020

COMMERCE.

Year.	Value of exports.	Value of imports.	Duties collected.
1880	$1,021,904	$5,600 00	$16,806 72
1881	1,137,496	3,356 00	18,980 02
1882	1,073,008	1,025 00	11,254 19
1883	969,834	2,334 00	11,067 37
1884	1,038,185	11 00	9,688 20

HENRY T. DUNN,
Special Deputy Collector.

N 12.

IMPROVEMENT OF BRUNSWICK HARBOR, GEORGIA.

The appropriations made by Congress since 1879 for improving Brunswick Harbor, Georgia, in conformity to the existing project, aggregate $70,000. Previous to beginning operations under this project, an appropriation of $10,000 had been made by the act approved July 4, 1836, and expended in partially removing a shoal in the same locality at which improvements have recently been made.

The existing project contemplates the construction of a jetty projecting from the most easterly point of Buzzard Island, located approximately parallel to, and about 1,000 feet distant from, the opposite shore, for the purpose of contracting the water-way and concentrating the currents. It provides, also, for more or less dredging where it is necessary to aid the action of the currents in deepening the channel.

The object of these operations is to establish and maintain a ship-channel of 15 feet depth at mean low water through the shoal situated about a mile below the city of Brunswick, where heretofore there existed a low-water depth only 9 feet. The cost of the project was estimated at $73,187.50.

No estimates were included in this plan for works at the upper end of Buzzard's Island or elsewhere that might eventually be necessary for increasing the ebb flow of Brunswick River (East River).

I have stated in previous annual reports that in order to fully attain the object in view the original estimates will be considerably increased.

The cost of dredging has been largely increased, both in regard to the price paid per cubic yard and the amount of material to be removed, and the jetty requires to be raised to a greater height to be effective. A few short spur-jetties may be needed on the left bank, opposite the jetty, in order to contract the water-way.

These were not included in the original project, as it was then thought that sufficient contraction would be secured by piers and wharves to be constructed by the riparian owners, but no such improvements have been made. A sill-dam should be built across the main stream (Turtle River), from the upper end of Buzzard's Island to the opposite shore of Blythe Island, to deflect a larger volume of water at ebb tide into East or Brunswick River. More or less dredging is also needed in the vicinity and for the same purpose. Additional appropriations, aggregating from $115,000 to $120,000, will have to be made for carrying out the enlarged project, more especially for work at the upper confluence of Turtle and Brunswick rivers, not included in the original plan.

OPERATIONS PRIOR TO JULY 1, 1884.

The main line of the jetty had been laid to a length of 4,199 feet. Its head reaches the 18-foot low-water curve of Turtle River. Its upper end being located at some distance from the projecting point of the east shore of Buzzard's Island, it is joined to it by a spur or return face of 310 feet length. This spur and the next adjoining 780 linear feet of the jetty are formed of palmetto cribs filled with brush and dredged material, and topped off with riprap stone. The depths of water vary here from 10 to 16 feet and over at low tide. The crest of the work reaches up to within a few feet of that level. The remaining portion of the jetty, 3,419 linear feet, built of double-raft mattresses, overlaid with brush and loaded with riprap stone, averaging 4 feet in thickness over

all, generally occupies more shallow water, varying from about 4 to 9 feet, except in approaching the head of the work, where the water rapidly deepens. The foundation mattresses were 30 feet wide, except the two last ones at the head, which are 40 feet in width.

The material removed by dredging—sand, loam, and clay, mixed in various proportions—aggregated 80,502 cubic yards. The dredging was carried on upon four parallel and adjoining lines parallel to the jetty and about 240 yards east of it. Each cut varied from 20 to 25 feet in width, and commences a little above the point of the junction of the jetty with its return face. With slight exceptions the cuts were made to a low-water depth of 15 feet; the longest cut measured 4,840 linear feet, reaching the 15-foot low-water curve of Turtle River. Its upper portion, for a length of about 1,000 feet, was only cut to a depth of 12 feet. Two other cuts of 15 feet depth and each about 4,400 feet in length approach the 15-foot curve, while the fourth cut of 12 feet depth extends only about 1,500 feet down-stream from the upper end. The depths of water at low tide in the vicinity and on either side of the line of dredging ranged from 8 feet to 11 feet.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1885.

With an appropriation of $10,000 made by the act of Congress approved July 5, 1884, the work of strengthening and raising the upper end of the jetty and its shore-protection was commenced in December, 1884. As the log and brush mattresses were somewhat different from those previously used in this work and described in former annual reports, the following extract from the specification is given:

> This mattress is a raft of round logs not less than 9 inches in average diameter, and not less than 6 inches in diameter at the small end, placed in close contact, side by side, and firmly held by transverse pole-binders spiked or bolted to them. There will be placed upon the raft of logs a layer of live-wood brush, sufficient to give 5 inches in thickness in the finished work, secured in place by poles lashed to the binders of the raft.
>
> The binders will be smaller logs or poles, not less than 4 inches in diameter at the small end, and placed not more than 8 feet apart, and those on the outside will be close to the ends of the logs.
>
> The logs and poles used may be loblolly or other cheap variety of pine, and must be of gentle taper and sufficiently straight. Logs will not be used that do not fit close enough together to hold all the stone securely, even without the use of brush.
>
> The mattress will be laid in sections of convenient length, in juxtaposition or with such laps as may be required, and gaps between adjacent mattresses will not be allowed.
>
> The width of mattresses may vary from 20 to 50 feet, as directed by the engineer in charge, the width being the dimension parallel to the logs.

In response to an advertisement inviting proposals, two were received, that of Mr. J. S. Howell being the lowest. His prices were 73½ cents per square yard for mattress, and $3.09 per cubic yard of stone. The work was awarded to him and a contract executed September 24, 1884.

During the long interval of over eighteen months since work under the previous contract had been suspended the outpour of water over the return face which connects the jetty with Buzzard's Island had produced dangerous scour along the base of this work; very strong ebb currents were found to run across it and behind the jetty, with deep water above and below. To insure the stability of the return face, the top of which was still from 3 to 5 feet below the level of low water, and to direct a stronger flow of water toward the channel past the wharves where most needed, an apron of 30-foot mattresses was sunk on the lower side along the base of the cribs, upon which courses of mattresses of 20 feet

width were built up to the level of the old crib-work. Additional courses of similar mattresses with riprap stone, resting partly upon the cribs and partly upon the built-up mattresses, were then laid, raising the crest to the height of mean high water, with a slope toward the angle of the junction with the jetty where it had a height of from 2 to 3 feet above mean low water. At this point the foot of the jetty itself was also protected by apron mattresses on either side.

The material used amounted to 6,752 square yards of mattresses and 990 cubic yards of stone.

Operations were suspended on May 31, 1885, for want of funds.

No appropriation having been made at the last session of Congress for continuing the improvement, no work can be done during the present fiscal year.

CONDITION AND EFFECTS OF THE WORK.

An examination made in the early part of June, 1885, has shown that the 9-foot low-water curve has increased in width and uniformity between the jetty and the opposite bulkhead line; the 12-foot curve near McCullough's Wharf has extended up stream, and the depths existing in 1884 have been maintained and at several places somewhat increased. It is certain, however, that better results could have been reported if an earlier and larger appropriation had been made, which might at least have permitted to raise both the return-face and the main jetty to a higher level, and to recover by dredging in the channel the depths lost by shoaling due to the unfinished condition of the jetty. It is, moreover, to be expected that the refractory shoal at the lower end of East River can be permanently held down only by increasing the volume of the ebb flow, to be secured by auxiliary works at the upper end, as stated in the first part of this report and in previous reports.

Otherwise the jetty is in good condition, to which the solidification of the riprap stone over cribs and mattresses by sand and shell-fish essentially contributes.

In former reports the growing importance of Brunswick Harbor as a commercial port from which vast quantities of timber, lumber, and naval stores are shipped has been pointed out. Its railroad connections westward to and beyond the Mississippi have been largely developed recently. The ship channel over the sea bar, in its unimproved condition, is one of the best on the South Atlantic coast of the United States. Vessels drawing from 22 to 23 feet of water can cross it at ordinary high water. Such a draught cannot be brought across the shoal in the East River below the city, where the depth is but 16 or 17 feet at high water. If the necessary appropriations should be made to remove this shoal vessels could load at Brunswick to the full depth permitted by the sea bar, and it is obvious that the volume and value of both the export and import trade would be rapidly increased.

This improvement is located in the collection district of Brunswick, Ga., at the port of entry. The import duties and other duties collected in 1884, amounted to $19,780.32.

Since the present plan of improvement was adopted appropriations have been made as follows:

By act of Congress approved March 3, 1879	$20,000
By act of Congress approved June 14, 1880	10,000
By act of Congress approved March 3, 1881	5,000
By act of Congress passed August 2, 1882	25,000
By act of Congress approved July 5, 1884	10,000
Total	70,000

Of this amount there had been expended up to June 30, 1885, $69,612.57.

The report of Mr. W. R. Curtis, assistant engineer, and a table of commercial statistics furnished by the collector of the port of Brunswick, are transmitted herewith.

Money statement.

July 1, 1884, amount available	$248 06
Amount appropriated by act approved July 5, 1884	10,000 00
	10,248 06
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	9,860 63
July 1, 1885, amount available	387 43
Amount (estimated) required for completion of existing project	75,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	75,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for construction of jetty in Brunswick Harbor, Georgia, opened September 11, 1884.

No.	Names of bidders.	Mattress, per square yard.	Stone, per cubic yard.	Aggregate cost of the work.	Date of commencing work, and monthly progress.
1	John S. Howell	$0 73½	$3 09	$6,981	As required by specification.
2	Atkins & Hoffman	65	3 48	7,631	Do.

Contract awarded to John S. Howell, at the prices stated.

REPORT OF MR. W. R. CURTIS, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Fernandina, Fla., June 30, 1885.

COLONEL: I have the honor to submit the following report of operations during the past fiscal year for "Improving Brunswick Harbor, Georgia."

Work commenced December 10, 1884, and ended May 31, 1885. The return-face of the jetty has been raised to high-water level at the shore end, with a slope of 4 feet to the outer end.

The old palmetto crib-work not being of sufficient width to be raised to the required height, a foundation course of log mattresses 30 feet wide was laid on the lower side of the old work, and a second course of 20-foot mattresses placed on this foundation course, raising the new work to the level of the old cribs. From this height the work was continued with their courses of 20-foot mats laid with a lap of 10 feet on the old cribs until the present crest was reached and the channel behind the jetty completely closed. Several 30-foot mats were laid at the upper side of the return-face, to guard against any scour from the increased current.

Table of work done.

Date.	Mattresses.	Stone.
	Square yards.	*Cubic yards.*
December, 1884	993.33	170.96
January, 1885	1,174.40	171.42
February, 1885	1,316.69	177.10
March, 1885	778.84	85.77
April, 1885	1,355.55	176.19
May, 1885	1,133.32	208.86
Total	6,752.13	990.30

An examination made June 3 and 4, 1885, shows the 9-foot curve of 1884 to have increased in width and uniformity in front of the city. The 12-foot curve near McCullough's wharf has advanced several hundred feet, and the depths found in 1884 have maintained, and at several points have increased.

Although the work has been completed but a short time there is a marked increase of ebb-current near the city shore.

A chart showing soundings in June 1885 accompanies this report.

Very respectfully, your obedient servant,

W. R. CURTIS,
Assistant Engineer.

Col. Q. A. GILLMORE,
Corps of Engineers U. S. A.,

COMMERCIAL STATISTICS.

Arrivals and clearances of vessels, and commerce at Brunswick, Ga., from January, 1878, to December 31, 1884.

ARRIVED.

Year.	Coastwise.			Foreign ports.						Total.		
				American vessels.			Foreign vessels.					
	Vessels.	Tonnage.	Crew.	Vessels.	Tonnage.	Crew.	Vessels.	Tonnage.	Crew.	Vessels.	Tonnage.	Crew.
1878	116	32, 584	850	36	10, 218	270	41	19, 008	493	193	61, 810	1, 613
1879	148	44, 397	1, 090	33	8, 235	232	40	17, 589	468	221	70, 221	1, 790
1880	271	77, 656	1, 892	36	11, 219	317	39	14, 996	432	346	103, 871	2, 641
1881	279	100, 451	2, 239	13	4, 174	98	63	30, 279	751	355	134, 904	3, 088
1882	335	123, 149	2, 659	7	2, 095	57	63	26, 958	694	405	152, 202	3, 416
1883	299	110, 302	2, 368	11	4, 814	107	87	40, 765	979	397	155, 881	3, 454
1884	239	88, 063	1, 893	10	4, 434	88	126	62, 818	1, 435	375	155, 315	3, 416

CLEARED.

1878	124	32, 767	874	28	9, 231	236	49	21. 268	550	201	63, 266	1, 660
1879	157	42, 345	1, 116	21	7, 172	172	47	21, 730	555	225	71, 247	1, 843
1880	270	78, 913	2, 010	14	5, 010	115	48	19, 977	550	332	103, 900	2, 675
1881	252	82, 155	1, 732	17	7, 218	156	87	42, 659	1, 014	356	132, 032	2, 902
1882	278	96, 170	2, 086	19	7, 761	170	101	48, 699	1, 139	398	152, 630	3, 395
1883	257	91, 036	1, 962	28	11, 268	240	124	55, 717	1, 369	411	158, 021	3, 571
1884	176	62, 927	1, 322	38	16, 209	335	148	70, 612	1, 633	362	149, 748	3, 290

COMMERCE.

Years.	Value of exports.	Value of imports.	Total collections.
1878	$1, 372, 842	$400	$4, 560 97
1879	1, 394, 401	3, 197	5, 644 33
1880	1, 702, 570	8, 098	17, 723 24
1881	2, 230, 000	4, 377	29, 305 30
1882	2, 700, 000	2, 739	20, 058 90
1883	3, 437, 000	3, 393	22, 911 61
1884	3, 500, 000	958	19, 780 32

N. T. DRUM,
Special Deputy Collector.

Improving BRUNSWICK HARBOR, GA.

under the direction of

Col. Q. A. Gillmore Corps of Eng'rs. Bvt. Maj. Gen. U.S.A.

W. R. Curtis, Civil Engineer, in local charge.

Chas. W. Field, Superintendent.

Scale of feet.

100 0 500 1000

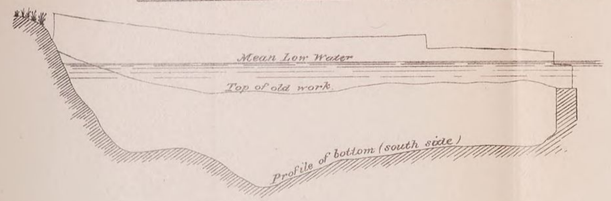
Accompanying annual report dated July 31st 1885
For the fiscal year ending June 30, 1885.

D. A. Gillmore
Col. Engrs. Bvt Maj Genl USA

Profile of return face of Jetty

Horizontal scale 50 0 50 100 ft.

Vertical scale. 10 0 10 20 ft.



Notes.

The shore line is from survey of 1883, with new wharves added.
The soundings were taken in June, 1885 and show depths at Mean Low Water.
The 3 foot curve is shown thus .....
12 " " " " " " — — — — —

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N 13.

IMPROVEMENT OF THE ENTRANCE TO CUMBERLAND SOUND, BETWEEN GEORGIA AND FLORIDA.

During the fiscal year ending June 30, 1885, the work of improving the entrance to Cumberland Sound, Georgia and Florida, was continued in accordance with the project submitted with my report of June 30, 1879, printed as Appendix I 8, Annual Report of the Chief of Engineers for 1879.

The plan of improvement comprises the construction of two low jetties composed of riprap stone resting upon a foundation mattress of logs or logs and brush, starting, respectively, from the shores or opposite sides of the entrance and extending seaward across the bar upon lines so directed that the outer ends will be parallel to each other and from 2,500 feet to 3,000 feet apart, or such distance as may hereafter be deemed necessary.

The available low-water depth has heretofore varied from 11 feet to 13 feet, with a mean rise and fall of tides of about 6 feet. Two low jetties reaching entirely across the bar would be expected to maintain a low-water channel not less than 20 feet to 21 feet deep. Greater depth may be secured by carrying the jetties to higher levels.

The cost of the work was estimated at $2,071,023.

On account of the exceptionally small appropriations made for carrying on this work, and the frequent and prolonged suspension of operations resulting therefrom, this original estimate of cost will doubtless be considerably increased.

SUMMARY OF OPERATIONS PRIOR TO JULY 1, 1884.

North jetty.—From its shore-end on Cumberland Island the foundation course or apron, consisting of log and brush mattresses overlaid with broken stone, extends 2,200 feet on a range bearing south 63½ degrees east, crossing Cumberland Channel. It then follows a range bearing south 80 degrees east for a length of 5,172 feet. The total length of the apron is therefore at present 7,372 feet. Its seaward end is located in shallow water not far from the North Breakers, north of Pelican Shoal The mattresses are from 25 to 52 feet wide and from 19 to 22 inches thick. At the deeper portions of Cumberland Channel, for a length of 1,493 a second course of mattresses, 20 feet to 25 feet wide, rests upon the bottom course. Here the foundations for two spurs were also laid on the south side of the jetty. Thus far 15,612 cubic yards of riprap stone had been used in the work.

South jetty.—The starting point of the south jetty is located on the eastern shore of Amelia Island, about 5,700 feet from Fort Clinch. The bottom course has been laid to an aggregate length of 4,167 feet, the mattresses varying from 40 to 87 feet in width. The shore end for a distance of 1,619 feet is directed due east. The rest is laid on a range north 68 degrees 32 minutes east. The work has reached the deep-water pocket east of Amelia Island. A total amount of 9,793.5 cubic yards of riprap stone has been deposited upon the mattresses.

	Feet.
Length of north jetty foundation June 30, 1884	7,372
Length of south jetty foundation June 30, 1884	4,167

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1885.

For continuing this improvement during the past fiscal year an appropriation of $75,000, made by act of Congress approved July 5, 1884, was available, together with a balance of $813.78 on hand July 1, 1884.

The work done was confined to extending the foundation course of the south jetty seaward.

On August 16, 1884, proposals were invited for expending the above-named appropriation in continuing the work on the jetties. Two designs for mattresses were described in the specifications, either one of which might be used at the option of the contractor. These designs were identical with those employed under the previous contracts for improving this locality and also the mouth of Saint John's River, Florida, of which a detailed description was given in my annual report upon the latter improvement for the year ending June 30, 1883.

Messrs. Lara and Ross were the lowest bidders, and a contract was made with them September 27, 1884.

Work was commenced on December 10, 1884, and terminated June 30, 1885.

The first mattress was placed about 75 feet inside from the outer end of the south jetty. The actual seaward advance of the bottom course during the past fiscal year aggregated 3,507 linear feet, following for that length the second range, adopted in November, 1882, bearing north 68 degrees 32 minutes east. The jetty has now reached a point whence another more easterly course will be taken, when operations can be resumed.

All the mattresses were 100 feet wide, about 18 inches thick, and loaded with 12 inches of stone, the outer end mattress receiving 6 inches thickness additional. The present outer end of the foundation course rests in 17 feet depth of water at low tide. Forty-two thousand five hundred and fifty-six square yards of mattresses and 13,487 cubic yards of riprap stone were used in the work during the fiscal year.

The length of the foundation courses of the two jetties, measured along their axes, are as follows:

	Feet.
Length of foundation of north jetty, June 30, 1885	7,372
Length of foundation of south jetty, June 30, 1885	7,667

No work can be done during the fiscal year just commenced unless an appropriation is made by Congress at an early day during the next session.

CONDITION AND EFFECTS OF THE WORK.

The ebb and flood currents, which at the beginning of last season's work crossed the south jetty obliquely, have lately been observed to have changed their direction, and now run about parallel to it. A remarkable shoaling has taken place on the last length of about 1,300 feet laid in May and June, 1885. A profile along the axis of the jetty was made about May 1, 1885. The greatest depths, nearly 25 at low water, then existed on the extreme outer 100-foot lengths. Back of this, to a point about 6,400 feet from the shore end, the depths varied from 20 to 21 feet. On this reach it was found that, as the work of sinking the new mattresses proceeded, a shoaling of about 2 feet had taken place in advance. In the deep pocket near the outer end the shoaling amounted to about 7 feet. Practically the irregular sea-bottom on the entire length mentioned had been leveled off and raised to a reduced and rather uniform low-water depth of about 18 feet. A similar though not so remarkable a shoaling in advance of the south jetty had also been noticed when operations were in progress about two years ago.

Near the shore end of the south jetty both the high and low water lines have advanced seaward several hundred feet since 1883.

No other special changes in the vicinity of the jetties or upon the bar have been observed since last year's report. It is possible that a survey now in progress may disclose some new facts.

I beg leave to invite attention to the fact that when operations were resumed under the last appropriation a period of about twenty-one months had elapsed during which no work had been done on the improvement for want of funds. The operations first commenced four years ago, and since that time the sum of $255,000 has been appropriated for the work, or less than one-eighth of the estimate cost of the project. At this rate of progress it will require between thirty and forty years to complete the project. The slowly-advancing and unfinished jetties remaining exposed to deterioration and injury from winds and waves, the total cost of the undertaking must unavoidably be increased, and the achievement of even a part only of the object in view will be indefinitely delayed.

Remarks have been made by me in former annual reports of the advantage peculiar to the harbor of Fernandina in regard to its large capacity and its deep and well-sheltered anchorage.

With a bar-channel deepened as proposed the port will become at once far more valuable and attractive for maritime and naval purposes, and will become in a large measure a convenient harbor of refuge.

For reasons here indicated, I urgently recommend that the next appropriation by Congress for this work be made at as early a date as possible, and that it be on a liberal scale.

This work is located in two collection districts, the north jetty being in the collection district of Saint Mary's, Ga , and the south jetty in that of Fernandina, Fla. Fernandina is the nearest port of entry. Import duties collected during the year 1884, $1,331.

The following appropriations have been made for the improvement of the entrance to Cumberland Sound:

By act of Congress approved June 14, 1880	$30,000
By act of Congress approved March 3, 1881	100,000
By act of Congress passed August 2, 1882	50,000
By act of Congress approved July 5, 1884	75,000
Total	255,000

The expenditures to June 30, 1885, including outstanding liabilities, were $251,301.69.

Since the cost of the approved project is estimated at $2,071,023, an aggregate sum of $1,816,023 has yet to be provided by appropriations.

The following drawings and papers are transmitted herewith:

Sheet 1. Chart showing location of south jetty and progress made in its construction to June 30, 1885, and present depth on the bar.

Sheet 2. Section of south jetty and plan of mattress as built to June 30, 1885.

Report of Mr. W. R. Curtis, assistant engineer.

A table of commercial statistics, furnished by the collector of the port of Fernandina.

Money statement.

July 1, 1884, amount available		$813 78
Amount appropriated by act approved July 5, 1884		75,000 00
		75,813 78
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$55,276 62	
July 1, 1885, outstanding liabilities	16,838 85	
		72,115 47
July 1, 1885, amount available		3,698 31

Amount (estimated) required for completion of existing project.....	$1,806,023
Amount that can be profitably expended in fiscal year ending June 30, 1887	600,000
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for construction of jetties in Cumberland Sound, Georgia and Florida, opened September 11, 1884.

No.	Names of bidders.	Mattresses per square yard.	Stone per cubic yard.	Aggregate cost of the work.	Date of commencing work and monthly progress.
1	Atkins & Hoffman.....	$0 67	$3 48	$57,710	As required by specifications.
2	Levi S. Burrows.....	0 74	3 49	59,850	Do.
3	J. H. Staats.....	0 69	3 35	56,860	Do.
4	Lara & Ross.....	0 59	3 09	51,100	Do.

Contract awarded to Lara & Ross at the prices stated.

REPORT OF MR. W. R. CURTIS, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Fernandina, Fla., July 1, 1885.

COLONEL: I have the honor to submit the following report of operations during the past fiscal year for "improving Cumberland Sound, Georgia and Florida."

Operations were confined to the extension of the south jetty. Its foundation course was extended from a point 4,160 feet from the shore end to a point 7,667 feet distant, the total advance being 3,507 feet. Work begun December 10, 1884, and ended June 30, 1885; 63 mattresses with a uniform width of 100 feet were used in this work, and were loaded with 12 inches of stone, except the outer mat, which received 18 inches.

When work was commenced in December, 1884, there was a strong current across the line of the jetty on both flood and ebb tides, the ebb current running nearly east-southeast and the flood current northwest.

The effect of the work done since that time has been to change this littoral current until at the present time it runs parallel with the axis of the jetty, and the tide-rip which marked the line of the jetty has nearly disappeared.

The shore-line has advanced several hundred feet near the shore end of the jetty since the survey of 1883, the low-water line being nearly out to "Kingsley's Bank."

No work has been done on the north jetty during the past fiscal year. An examination made on June 29, 1885, shows the shore end to be well sanded over above low-water. The exposed portions on the shoal are well protected by sand and shells which completely cover the rock where seen.

No apparent change has taken place since 1884. The brush and log binders of the more exposed mattresses were gone, but the logs are in good condition and not much injured by worms.

LENGTH OF COURSES OF NORTH JETTY, JUNE 30, 1885.

	Feet.
Foundation course	7,372
Second course	1,439
Total (both courses)	8,811

Soundings taken on the bar on June 26 show a depth of 12 feet below mean low water of United States Coast Survey establishment. The gauge to which these soundings were referred is located on the wreck of the steamer City of Austin, near the outer end of the south jetty, and is probably correct to within 0.05 feet.

The following table shows the amount of work done during the year:

Date.	Mattress.		Stone.
	No.	*Square yards.*	*Cubic yards.*
December, 1884	3	2,029.89	753.67
January, 1885	6	4,064.98	1,353.51
February, 1885	7	4,756.77	1,420.53
March, 1885	9	6,059.34	2,168.25
April, 1885	10	6,731.33	1,969.15
May, 1885	20	13,498.54	3,375.14
June, 1885	8	5,414.88	2,447.04
Totals	63	42,555.73	13,487.29

Improving CUMBERLAND SOUND, GA & FLA.

Under the direction of

Col. Q. A. Gillmore, Corps of Engrs. Bvt. Maj. Gen. U. S. A.

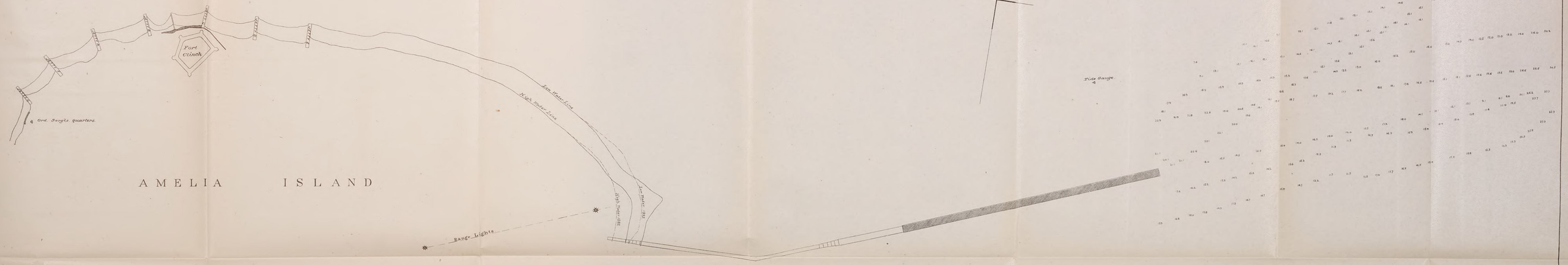
W. R. Curtis, Civil Engineer in local charge.

Sheet No. 1.

Showing location of South Jetty, the progress made in its construction to June 30, 1885.

and present depths on the Bar.

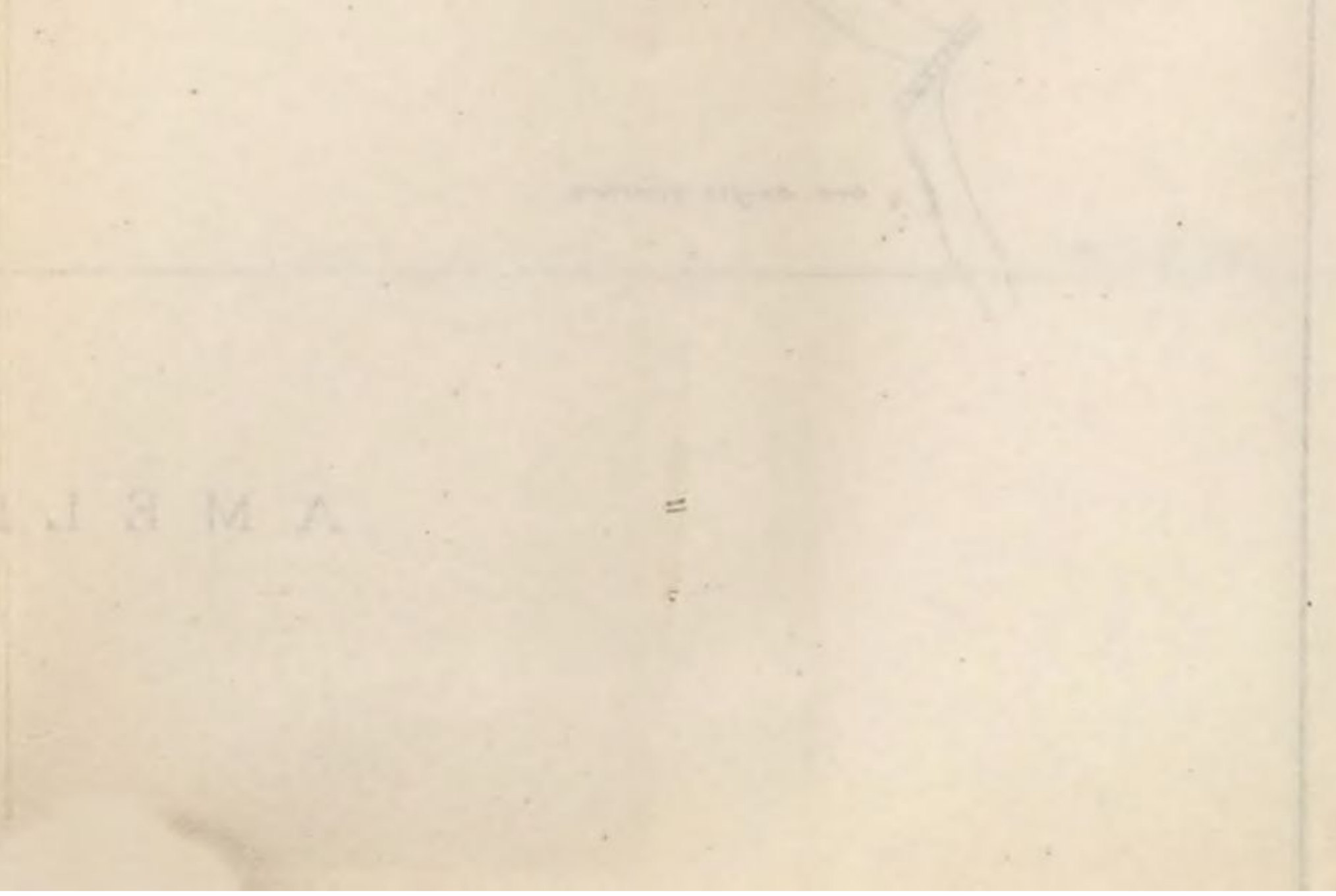
Scale of feet.



Accompanying annual report dated July 31st 1885
for the Fiscal year ending June 30, 1885.

Q. A. Gillmore
Col. Engrs. & Bvt. Maj. Gen. U.S.A.

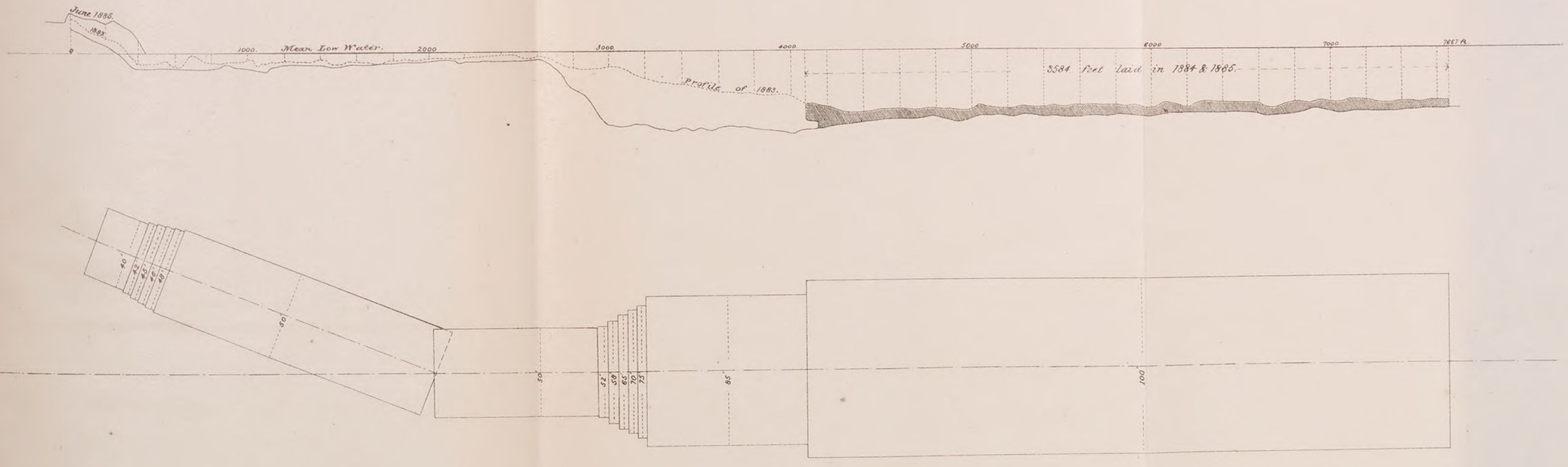
H Ext pt2 v2 491



Improving CUMBERLAND SOUND, GA. & FLA.

Sheet 2.

Section of South Jetty and plan of mattress
as built to June 30, 1885.



Scale of Lengths.
100 0 500 1000 ft.

Scale of Heights.
10 0 10 20 30 ft.

Scale of Widths.
10 0 50 100 ft.

Accompanying annual report dated July 31st 1885,
for the fiscal year ending June 30, 1885.

D. A. Gillmore
Col. Engrs & Bvt Maj Genl

H Ex1 pt2 v2 49 1

A progress chart and profile of work accompanies this report.
This work is in the collection district of Fernandina, Fla., which is the port of entry.
Very respectfully, your obedient servant,

W. R. CURTIS,
Assistant Engineer.

Col. Q. A. GILLMORE,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

Arrivals and clearances of vessels and commerce at Fernandina, Fla., from January 1, 1877, *to December* 31, 1884.

ARRIVED.

Years.	Coastwise.			Foreign ports.						Total.		
				American vessels.			Foreign vessels.					
	Vessels.	Tonnage.	Crew.	Vessels.	Tonnage.	Crew.	Vessels.	Tonnage.	Crew.	Vessels.	Tonnage.	Crew.
1877	150	100, 581	3, 343	32	8, 088	217	40	12, 541	404	222	122, 200	3, 782
1878	185	120, 865	3, 900	16	3, 985	101	42	8, 294	215	223	133, 144	4, 225
1879	199	133, 309	4, 138	28	9, 634	252	10	5, 645	126	237	148, 588	4, 516
1880	260	156, 740	4, 470	34	22, 396	598	22	9, 463	240	316	188, 599	5, 308
1881	227	171, 584	4, 186	17	11, 865	314	24	11, 592	271	268	195, 041	4, 771
1882	248	146, 422	3, 274	16	9, 056	242	15	6, 639	151	279	162, 117	3, 667
1883	170	95, 773	2, 453	6	1, 769	43	13	5, 239	137	189	102, 781	2, 633
1884	176	105, 091	2, 864	3	865	21	8	3, 328	88	187	109, 284	2, 973

CLEARED.

1877	165	106, 638	3, 590	24	6, 340	166	42	13, 641	412	231	126, 619	4, 168
1878	195	124, 883	4, 086	19	4, 911	123	25	9, 080	236	239	138, 874	4, 445
1879	205	129, 650	4, 079	31	11, 066	258	12	8, 026	164	248	148, 742	4, 501
1880	246	155, 649	4, 505	31	14, 161	327	24	10, 202	240	301	180, 012	5, 072
1881	204	137, 638	3, 730	41	22, 018	506	31	15, 335	351	276	174, 992	4, 587
1882	217	138, 676	3, 166	39	15, 507	370	30	14, 963	321	286	169, 146	3, 857
1883	153	87, 842	2, 245	32	8, 925	210	24	9, 413	231	209	106, 180	2, 688
1884	178	104, 362	2, 688	26	8, 809	176	15	6, 488	158	219	119, 659	3, 022

COMMERCE.

Years.	Value of exports.	Value of imports.	Duties collected.
1877	$315, 446	$19, 639	$2, 376
1878	258, 184	11, 862	2, 090
1879	283, 476	11, 047	3, 424
1880	259, 514	15, 679	7, 808
1881	377, 887	14, 537	8, 183
1882	364, 513	43, 645	36, 590
1883	244, 587	15, 758	5, 566
1884	171, 340	6, 859	1, 331

C. V. HILLYER,
Deputy Collector.

N 14.

IMPROVEMENT OF INSIDE PASSAGE BETWEEN FERNANDINA AND SAINT JOHN'S RIVER, FLORIDA.

Appropriations for the improvement of this route aggregating $78,000 were made at various times between the years 1828 and 1838. A further appropriation of $10,000 was made in 1874, and two others, of $7,000 each, by the acts approved March 3, 1879, and June 14, 1880, respectively.

Only $2,565.55 of the amount last appropriated had been expended when the work was stopped.

As suggested in previous reports, the recently completed direct line of railway between Fernandina and Jacksonville and the improvement of the bar at the mouth of Saint John's River afford passengers and freight a choice between transit by rail and transit by sea and river by coasting steamers, and the neccessity for continuing the improvement of this inside passage is therefore not urgent at the present time; still the inside passage between Savannah and Jacksonville, which actually continues far into the interior of Florida by means of the Saint John's River, may be considered a valuable water route for many purposes. Its importance in the case of the United States becoming involved in war with a maritime power has been pointed out in former reports. Its improvement, when undertaken, should be on a liberal scale.

The following appropriations have been made for this work since 1874:

By act of Congress approved June 23, 1874	$10,000 00
By act of Congress approved March 3, 1879	7,000 00
By act of Congress approved June 14, 1880	7,000 00
Total	24,000 00

The total expenditures since 1874, including the cost of survey, were $19,565.55.

This inland route is partly in the collection district of Fernandina and partly in that of Saint John's, of which Fernandina and Jacksonville are the respective ports of entry.

Money statement.

July 1, 1884, amount available	$4,434 45
July 1, 1885, amount available	4,434 45

N 15.

PRELIMINARY EXAMINATION OF DARIEN HARBOR, AND THE ALTAMAHA RIVER, FROM DARIEN TO ITS MOUTH, GEORGIA.

UNITED STATES ENGINEER OFFICE,
New York, November 3, 1884.

GENERAL: The river and harbor act approved July 5, 1884, provides for a preliminary examination being made of Darien Harbor and the Altamaha River, from Darien to its mouth, Georgia. The work was assigned to my charge by Department letter dated July 31, 1884, with instructions to state in my report whether, in my judgment, the harbor or river is worthy of improvement, and, if so, to accompany the report with an estimate of the cost of making a survey, including a project and estimate of improvement.

The examination was made under my direction by my assistant, Capt.

T. N. Bailey, Corps of Engineers, and I have the honor to submit the following report:

Darien Harbor is understood to mean Darien River, from the town of Darien to its entrance in Doboy Sound and the Atlantic Ocean. This river is the northerly main branch of Altamaha River, which divides into several channels about 12 miles above Darien. The middle or most important southerly branch of the delta retains the name of Altamaha River; it enters the Atlantic Ocean through Altamaha Sound. Below Darien it is separated from Darien River by General's and Rockedundy islands.

There is no commerce on the Altamaha branch except some transportation of rice crops in vessels of shallow draught. The bar at the entrance has not over 15 feet of water at high tide, and the channel over it is not buoyed.

The mean rise and fall of the tide is 7 feet.

The outlet by way of Darien River is naturally the best, and is used almost exclusively by the commerce of Altamaha River and its tributaries.

It appears that the navigation of Darien Harbor and river has more or less deteriorated of late years, and serious apprehensions are entertained by the business community of Darien that its value as a shipping port will rapidly decline unless its improvement is undertaken by the General Government.

Several shoals which obstruct navigation between the town and Doboy Island require to be removed to enable vessels that can cross the bar to receive their full cargoes at Darien itself. Four of these shoals were temporarily improved by dredging in 1879, by means of an appropriation of $8,000 made by act of Congress approved June 18, 1878, and low-water depths of from 12 to 14 feet were obtained; but these depths do not seem to have been preserved.

There are some shoal places above Darien which seriously impede steamboats and rafts on their way to that town, notably Cooper's Bar, 6 miles above, which has its former low-water depth of 3 feet now reduced to about 6 inches.

It should be stated, also, that prior to 1875 vessels drawing nearly 22 feet could pass Doboy Bar at common spring tides; whereas pilots do not now consider it safe to carry out vessels loaded deeper than 18 or 19 feet. It seems that the existing channel is gradually filling up, and that a new channel to the northwest is in progress of formation.

Captain Bailey's report, which is herewith transmitted, includes several letters from prominent business men at Darien, containing interesting information and some statistics, to which attention is invited.

In view of the undoubted importance of Darien as a shipping port for the products of the vast area of fine timber land drained by the Altamaha, the Oconee, Ocmulgee, and many other affluents, Darien Harbor and River are considered worthy of improvement, and it is recommended that the sum of $1,650 be allotted for making the necessary survey and gaugings between Darien and the mouth of the river and for an examination of the entrance from the sea across Doboy Bar.

Altamaha River, "from Darien to its mouth," is not recommended as being worthy of improvement.

Very respectfully, your obedient servant,

Q. A. GILLMORE,
Colonel of Engineers, Bvt. Maj. Gen., U. S. A.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

REPORT OF CAPTAIN THOMAS N. BAILEY, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Charleston, S. C., October 22, 1884.

COLONEL: In compliance with your instructions of August 5, 1884, I have the honor to submit the following report of an examination of "Darien Harbor, and the Altamaha River from Darien to its mouth, Georgia":

"Darien Harbor" is interpreted, by direction, to mean the harbor proper, and the Darien River from Darien to Doboy Sound. The "Altamaha River from Darien to its mouth" is understood to refer to the Altamaha River from about General's Cut to Altamaha Sound, or its sea bar.

Darien is not on the Altamaha River. This report is based on information received from the following sources: An extensive correspondence and personal interviews with prominent citizens of Darien and vicinity; an examination of Coast Survey charts; data previously received by personal visits to Darien; examinations made during recent work on Lower Altamaha; published reports of the Chief of Engineers, U. S. A., and other sources. The Altamaha is the most important river of Georgia. It is formed by the Oconee and Ocmulgee, and is 155 miles long to Darien. It enters the Atlantic Ocean through Altamaha Sound.

From a point about 12 miles above Darien, seaward, the river divides into a number of channels; those to the south collect in Altamaha Sound, while the Darien River, from Darien to Doboy, is the main northern one, and flows into Doboy Sound. There are numerous links connecting the arms of the delta.

The Darien River outlet, being naturally the best, is the one almost exclusively used by the Altamaha River commerce. The business over the other outlet is comparatively slight. It has not been considered necessary to buoy the entrance to Altamaha Sound.

There have been appropriated to date, for improving the Altamaha River and its tributaries, about $125,000.

The present project for improving the Altamaha River contemplates an 80-foot channel, 3 feet deep at low stage, down as far as Darien.

Under this project the obstuctions above Darien, herein referred to, can receive attention. It would appear advantageous, however, to include this part of the stream above Darien in any project for improving Darien Harbor.

At present the deepest usual draught which can be carried through Darien Harbor (*i. e.*, Darien to Doboy) is 14 feet. The principal obstructions are six shoals of mud and sand, bearing a depth of from 8½ to 10 feet at mean low tide. The rise of the tide here is about 6.5 feet. In 1879 $8,000 was expended in dredging some of these shoals, to afford temporary relief; they were cut to a mean low-water depth of from 12 to 14 feet. It is claimed by Capt. J. I. Chancy, an experienced Darien pilot, that if these shoals were permanently improved to a 14 or 15 foot mean low-water depth, vessels drawing from 20 to 21 feet could pass from Doboy to Darien.

Vessels now receive their deep-draught loads at Doboy, although Darien is the shipping port. From Doboy to sea, the only obstruction is Doboy Bar. This bar is about 4 miles southeast of Sapelo light-house; is between the "north breaker" and the "south breakers" of Coast Survey chart No. 446.

The soundings in this vicinity on chart were taken in 1868; they show a minimum mean low-water depth of 14 feet at the site of Doboy Bar.

The present reported mean low-water depth on the bar is 11 feet, and it is stated to be only 200 feet through the crest at a 14-foot depth.

I have been informed that the bar had a depth of from 21 to 22 feet at mean high water (tide 7 feet) from 1860 to about 1874; since the latter date it has shoaled to about 18 feet, mean high water.

I submit the following letters and extracts:*

* * * * * * *

It appears that the improvement of Doboy Bar is of the most importance.

This would not be included in the defined "Darien Harbor."

Statement of the marine and export trade of the port of Darien, Ga.

Items.	Year.		Year ending June 30—			
	1878.	1879.	1881.	1882.	1883.	1884.
Number of vessels	187	172	275	235	192	184
Tons	94,784	81,378	134,019	109,436	89,324	86,724
Average tonnage	507	473	487	466	465	471
Hewn timber ....feet..	28,163,100	21,946,542	44,443,042	25,709,502	12,542,607	20,507,181
Sawn timber ....do..	24,078,656	22,901,474	41,061,516	44,188,787	46,191,296	37,309,541
Deals....do..	13,435,191	13,404,899	9,171,052	7,894,656	7,322,264	6,164,177
Shipped via St. Simons..do..	8,496,464	9,000,000	9,721,837	6,204,184	4,172,019	4,978,528
Total	74,173,411	67,252,915	104,397,447	83,997,129	70,228,186	68,959,427

*Omitted. Printed in House Ex. Doc. No. 260, Forty-eighth Congress, second session.

Further reasons for improving Darien Harbor are:

(1) To secure the full benefit of the expenditures already made on the Altamaha and its tributaries.

(2) Military considerations—Darien Harbor being part of the eastern branch of the proposed southern transportation route connecting the Mississippi River at Paducah, by the way of the Tennessee, Ocmulgee, and Altamaha rivers, with the Atlantic Ocean and the harbor, is also part of the inside route or interior coast line of water communication which has recently received the attention of Congress.

The work is in the collection district of Brunswick. Darien is the nearest port of entry, and Sapelo the nearest light-house. Amount of revenue collected at port of Darien, Ga.—

Fiscal year ending June 30—	
1881	$26,444 23
1882	13,929 66
1883	12,151 15
1884	13,681 73

From all the foregoing I am of the opinion that "the Altamaha River, from Darien to its mouth, Georgia, is not worthy of improvement," and that "Darien Harbor, Ga.," is worthy of improvement.

Very respectfully, your obedient servant,

THOS. N. BAILEY,
Captain, Corps of Engineers.

Col. Q. A. GILLMORE,
Corps of Engineers, U. S. A.

N 16.

SURVEY OF DARIEN HARBOR, GEORGIA.

UNITED STATES ENGINEER OFFICE,
New York, January 30, 1885.

GENERAL: I have the honor to submit herewith the following report of a survey of Darien Harbor, Georgia, made in pursuance to instructions contained in Department letter dated November 21, 1884. A preliminary examination of the locality assigned to my charge by the letter of the Chief of Engineers of July 31, 1884, had previously been made under my direction, my report of which was forwarded under date of November 3, 1884.

The survey of Darien Harbor was made under my direction by Capt. T. N. Bailey, Corps of Engineers, who was assisted in the work by Mr. J. P. Allen and Mr. W. R. Curtis, assistant engineers.

Darien Harbor is generally understood to mean Darien River from the town of Darien to its entrance into Doboy Sound, a length of about 12 miles measured along the tortuous channel of the river.

About 12 miles above Darien the Altamaha River divides into two branches, which are further subdivided in approaching the Atlantic Ocean. The south branches collect in Altamaha Sound. Darien River forms the northerly main branch, and is separated from the southerly main branch which retains the name of Altamaha River by General's and Rockedundy Islands.

The best navigable channel is in Darien River; it is almost exclusively used by the Altamaha River commerce.

The banks of the river are muddy and low, at about the level of high water. In entering the river from the sea, the first high land of any extent met with is occupied by the town of Darien.

The survey had shown that the navigation of Darien River is at seven points more or less obstructed by shoals with mimimum low-water depths over them of from 6.3 to 10.6 feet. The several reaches between

these shoals have nowhere less than 12 feet depth at mean low water. The shoals are scattered over a length of river of $9\frac{3}{4}$ miles from Darien to Doboy Island. The mean rise and fall of tides in the river is $6\frac{1}{2}$ feet. Owing to the obstructions mentioned, the present high-water draught of vessels is limited to 13 or 14 feet. From Doboy down river there is sufficient depth of water for vessels that can cross Doboy Bar, and sea-going vessels cannot, therefore, complete their cargoes at Darien but have to proceed to Doboy for that purpose.

From letters of prominent business men in Darien and vicinity, copies of which are given in Captain Bailey's report, it appears that Doboy Bar has been getting shoaler during the last fifteen or sixteen years. Its low-water depth was 14 feet in 1868; according to present reports of pilots it is now only 10.6 feet. The letters agree in stating that in 1875, and previously, vessels drawing 21 or $21\frac{1}{2}$ feet could cross the bar, while at present pilots deem it unsafe for vessels to load deeper than 19 feet at highest spring tides.

Between Darien and the point about 12 miles above where the Altamaha is divided into two streams, there are three places where the river is obstructed by shoals, namely, at Wesleyhorn, Couper's or Cooper's Bar, and at the junction of Darien River and the south branch of the Altamaha, located 10, 6, and 3 miles, respectively, above Darien. Couper's Bar, especially, needs improvement; there is scarcely any water over it at low tide, causing great inconvenience, since all the timber brought to Darien and all steamboats plying on the Altamaha and its tributaries are compelled to cross this shoal. It seems, however, that this portion of the river cannot properly be included in the designation of "Darien Harbor," but that it forms part of Altamaha River, for the improvement of which appropriations have been made of late years.

By act of Congress approved June 18, 1878, the sum of $8,000 was appropriated for the improvement of the harbor at Darien, Ga. This was the first and only appropriation thus far made for this work. It was expended in dredging on three of the shoals in Darien River, referred to above, and on a shoal in North or Ridge River, which enters Darien River near Doboy. These operations afforded temporary relief to navigation, and were not expected to do more than this.

Captain Bailey suggests a project for improving Darien Harbor from Darien to Doboy, with a view of establishing a continuous navigable channel with a minimum low-water depth of not less than 12 feet, which would increase the available mean high-water depth of 18 or 19 feet, whereas at present it practically only amounts to 13 or 14 feet. Vessels of correspondingly increased draught could then come in or go out of the harbor and over the bar on the same tide.

The project which is approved and herewith recommended to the Department embraces the removal of seven shoals between Darien and Doboy by dredging to a minimum depth of $12\frac{1}{2}$ feet; and also the construction of wing-dams at five of these shoals for maintaining the depth of the improved channel. The dams are proposed to be built of log mattresses loaded sufficiently with riprap stone. They will be highest at the shore ends and for some distance out, then gradually diminish in height and end in an apron or toe next to the channel. The approximate location of the dams is indicated upon the accompanying chart* of the survey, except that of the work on Shoal No. 1, near Doboy, which is for the present omitted in order to give the matter further study.

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* Omitted.

It is estimated that about 6,400 linear feet of wing-dams have to be built, and 172,000 cubic yards of material to be removed by dredging, at a probable aggregate cost of $170,000. The project is, of course, subject to such modifications in the locations of the wing-dams, and in the details of construction, as a longer study of the subject may suggest as necessary or expedient.

Darien by last census had a population of 2,000. It is an important point for the export of timber and lumber, being the natural outlet for the pine-forest products of at least nineteen counties of the State of Georgia, of an aggregate area of about 14,000 square miles, drained by the Altamaha and its numerous tributaries. The population of these counties was, in 1880, over 150,000, an increase of nearly 30 per cent. since 1870. Thousands of people find occupation in procuring, manufacturing, handling, and shipping these products. This business will probably go on for many years, for, although the most valuable timber now available is more distant from the rivers, it is also said to improve in quality, and tramways are built in some localities for hauling it. Cypress is believed to exist in very large quantities, and is extensively exported.

The annual rice crop of the Altamaha is at present from 150,000 to 200,000 bushels. There is a large extent of land on that river and its tributaries well adapted to the cultivation of this cereal not yet brought under bank.

It seems that shippers in Darien begin to experience trouble in obtaining as favorable freight terms as those which prevail in neighboring ports, owing to the condition of the harbor, and especially to the shoal navigation on the bar.

From a letter from the city and county authorities at Darien, forming part of Captain Bailey's report of the survey, it appears that during the last three years the annual export of timber and lumber averaged over 87,000,000 feet, valued at $1,200,000.

The work is located in the collection district of Brunswick, Georgia. Darien is the nearest port of entry, and Sapelo the nearest light-house. Amount of revenue collected at the port of Darien during the fiscal year ending June 30, 1884, $13,681.73.

The report of Capt. T. N. Bailey, Corps of Engineers, and the chart of the survey, are sent herewith.

Very respectfully, your obedient servant,

Q. A. GILLMORE,
Colonel of Engineers,
Bvt. Maj. Gen., U. S. A.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

REPORT OF CAPTAIN THOMAS N. BAILEY, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Charleston, S. C., January 15, 1885.

COLONEL: In compliance with your instructions of November 22, 1884, I have the honor to submit the following report of a survey of Darien Harbor, Georgia, made in December, 1884, and January, 1885. Darien Harbor was interpreted, by direction, to mean the harbor proper and the Darien River, from Darien to Doboy Sound.

The Altamaha is the most important river of Georgia. It is formed by the Oconee and Ocmulgee, and is 155 miles long to Darien. It enters the Atlantic Ocean through Altamaha Sound.

From a point about 12 miles above Darien seaward, the river divides into a number

of channels. Those to the south collect in Altamaha Sound, while the Darien River, from Darien to Doboy, is the main northern one, and flows into Doboy Sound.

There are numerous links connecting the arms of the delta.

The Darien River outlet, being naturally best, is the one almost exclusively used by the Altamaha River commerce. The business over the other outlets is comparatively slight.

It has not been considered necessary to buoy the entrance to Altamaha Sound.

There has been appropriated to date, for improving the Altamaha River and its tributaries, about $125,000.

The present project for improving the Altamaha River contemplates an 80-foot channel, 3 feet deep, at low stage, down as far as Darien. Under this project the obstructions above Darien, herein referred to, can receive attention. It would appear advantageous, however, to include this part of the stream above Darien in any project for improving Darien Harbor.

In 1879 $8,000 were expended in dredging shoals in Darien Harbor to afford temporary relief. They were cut to a mean low-water depth of from 12 to 14 feet. The rise of tide here is about 6½ feet.

* * * * * * *

DARIEN TO DOBOY.

Depths refer to mean low water. At Darien the river is about 400 feet wide, with a 12-foot channel, deepening in some parts to 15 or 16 feet. At Shoal No. 5, near General's Cut, the channel depth reduces to 9.6 feet. General's Cut is used only by small boats.

Below this shoal the river widens to 500 feet and affords a 12-foot channel, which, in narrow parts, carries 15 feet. Just above Pico Cut the river is 450 feet wide. The cut is at present 200 feet wide, with 15 feet of water through it; it is gradually widening and the old bend of the river is shoaling. Lower Bluff saw-mill is situated in this bend.

At the mouth of May Hall Creek the river 1,250 feet wide. There is a saw-mill up this creek.

Three Mile Cut joins the river just below Shoal No. 1½. The soundings indicate that the flood and the ebb follow the same chanel at the mouth of the cut.

This cut is used at high tide by the steamers of the inside route.

The channel bottom throughout Darien Harbor is generally hard sand; there are some mud banks, and mud is generally found near the river banks; the latter are at about the height of high tide of soft mud, and present the usual characteristics of the salt marshes of the vicinity.

Detailed information is given in the following table, and by the map accompanying this report.

Locality.	Below Darien.	Length of shoal.	Depth on shoal at mean low water.		Width of Darien River.	Depth in reaches between the shoals at mean low water.		
			Least.	Average.		Least.	Average	Greatest.
	Miles.	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*
Shoal No. 5	¼	500	9.6	10.5	400	.....	.....	.....
General's Cut	¾	.....	.....	.....	450	12.0	13.0	34.6
Shoal No. 4	1¼	600	7.0	8.0	500	.....	.....	.....
Pico Cut	1½	.....	.....	.....	200	15.2	16.0	20.0
Shoal No. 3½	1¾	300	10.6	11.5	600	.....	.....	.....
Between Shoals 3½ and 3	.....	.....	.....	.....	.....	14.5	20.0	38.0
Shoal No. 3	2¾	1,800	6.3	8.0	750	.....	.....	.....
Between Shoals 3 and 2	.....	.....	.....	.....	.....	12.6	20.0	28.6
Shoal No. 2	3½	1,400	8.0	10.0	1,000	.....	.....	.....
May Hall Creek	4½	.....	.....	.....	1,250	12.3	13.0	15.4
Shoal No. 1½	4¾	2,800	8.2	10.0	1,200	.....	.....	.....
Three-mile Cut	5	.....	.....	.....	1,150	.....	.....	.....
Rockedundy River	6¼	.....	.....	.....	800	.....	.....	.....
King's Cut	6¼	.....	.....	.....	450	12.9	21.0	33.6
Catfish Creek	8	.....	.....	.....	650	.....	.....	.....
Back River	9¼	.....	.....	.....	1,400	.....	.....	.....
Shoal No. 1	9¾	850	7.6	9.0	2,600	.....	.....	.....
Doboy	10¼	.....	.....	.....	1,(00	.....	.....	.....
Doboy Bar	19¼	.....	.....	.....	.....	.....	.....	.....

Logs were struck while sounding, and the banks were found lined with binders from rafts and slabs from the saw-mills. It would seem that it is the practice by many to turn such material adrift, to be picked up by woodmen or left to sink in the channel.

The population of Darien is about 2,000 and of Doboy about 400.

The amount of dry land at Doboy suitable for extension of the town is limited, and it lacks communication with the interior by land; Darien possesses the latter, and it is the nearest high land of extent one meets from sea.

The reach above Darien into the Altamaha is obstructed by several shoals carrying from 1 to 2 feet at low water.

Couper Bar is the worst one; the North Branch here is practically dry at low water, at which stage the channel is through a narrow drain, 2½ feet deep, crooked, and accommodating small boats only.

From Doboy to sea, the only obstruction is Doboy Bar. This bar is about 4 miles southeast of Sapelo Light-house; is between the "North breakers" and the "South breakers" of Coast Survey Chart No. 446.

The soundings in this vicinity on chart were taken in 1868; they show a minimum mean low-water depth of 14 feet at the site of Doboy Bar.

The present reported mean low-water depth on the bar is 10.6 feet, and it is stated to be only 200 feet through the crest at a 14-foot depth.

I have been informed that the bar had a depth of from 21 to 22 feet at mean high water (tide 7 feet) from 1860 to about 1874.

Since the latter date it has shoaled to about 18 feet at mean high water.

The north or slough channel over the sea bar is reported to be deepening. It is now about 14 inches shoaler than the channel over Doboy Bar.

There are obstructions, then, both above and below Darien Harbor, in the reach connecting the Altamaha River with the sea.

The interests of Darien Harbor may be divided into three classes:

First. The steamboat traffic down the Altamaha and towards Savannah; the traffic of the "Inside Route"; the rice-boat traffic; rafting interests.

Second. The lumber shipping by coasters, of an average draught of 15 feet, which could load at Darien; rafting interests.

Third. The lumber export business, in draughts of 17 to 20 or more feet, the deeper draughts loading at Doboy, as is now the practice; rafting interests.

The general rafting interests would be benefited by works aiding either of these three classes.

There is ample water now in Darien Harbor to accommodate the interests of the first class. The improvements of most benefit to this class would be those from Darien upward to the Altamaha, coming under the appropriation for improving Altamaha River, Georgia.

Improving Darien Harbor would particularly and almost exclusively benefit the second class of interests.

Deepening Doboy Bar would greatly benefit the third class, and effectively help the other interests.

It appears, then, that more benefit would result from an expenditure above Darien Harbor, or below it, than would be secured by improving the Harbor (Darien to Doboy).

The seven shoals of Darien Harbor are connected by reaches carrying at least 12 feet at mean low water. Should the shoals be permanently reduced to this same depth, the efficiency of the harbor would be largely augmented.

At present the deepest usual draught afforded by the harbor is from 13 to 14 feet. This would be increased to from 19 to 20 feet by the reduction of the shoals, as above. A vessel could then come in or go out of the harbor and over Doboy Bar on the same tide.

I submit the following estimate for securing a mean low-water depth of at least 12 feet throughout Darien Harbor. The same general plan could be extended to secure a greater depth.

The lengths and locations of the proposed dams are shown in the map herewith. I have estimated for log-raft mattresses, brushed and loaded with from 5 to 9 inches of riprap stone, and bearing a 13-inch crowning.

In profile the dams are kept at mean high water for about one-third of their lengths, then at half tide for a distance equal to half the length of the dams, sloping down gradually to an outer toe.

Dredging is to be done to facilitate the removal of the shoals and direct the new channels.

At Shoal No. 1, I suggest a dam to the height of low water only. A full investigation of tidal currents at this peculiar locality, and a more thorough study of the probable effect of the proposed dam, should precede its final adoption.

I use the following prices:

Mattress, 65 cents per square yard; riprap stone, 3.25 cents per cubic yard; dredg-

ing, 22 cents per cubic yard. I add 20 per cent. to cover the possible expense of necessary shore-protection, and for contingencies.

Shoal No. 5:	
8,333 cubic yards of dredging	$2,200
Shoal No. 4:	
15,555 cubic yards of dredging, 4,666 square yards of mat, and 960 cubic yards of stone	11,491
Shoal No. 3½:	
4,000 cubic yards of dredging	1,056
Shoal No. 3:	
46,666 cubic yards of dredging, 14,000 square yards of mat, and 2,880 cubic yards of stone	34,472
Shoal No. 2:	
25,926 cubic yards of dredging, 20,972 square yards of mat, and 4,228 cubic yards of stone	39,692
Shoal No. 1½:	
51,872 cubic yards of dredging, 14,444 square yards of mat, and 3,400 cubic yards of stone	38,216
Shoal No. 1:	
18,888 cubic yards of dredging, 23,333 square yards of mat, and 4,600 cubic yards of stone	41,127
Total	168,254

Darien Harbor is part of the Eastern Branch of the proposed Southern transportation route connecting the Mississippi River, near Paducah, by way of the Tennessee, Ocmulgee, and Altamaha rivers, with the Atlantic Ocean; and the harbor is also part of the "Inside Route" or interior coast-line of water communication, which has recently received the attention of Congress.

The work is in the collection district of Brunswick. Darien is the nearest port of entry, and Sapelo the nearest light-house.

AMOUNT OF REVENUE COLLECTED AT PORT OF DARIEN, GEORGIA.

Fiscal year ending June 30—	
1881	$26,444 23
1882	13,929 66
1883	12,151 15
1884	13,681 73

The survey was made with much skill and energy by Assistant Engineers James P. Allen and W. R. Curtis.

Very respectfully, your obedient servant,

THOS. N. BAILEY,
Captain, Corps of Engineers.

Col. Q. A. GILLMORE,
Corps of Engineers, U. S. A.

APPENDIX O.

IMPROVEMENT OF RIVERS AND HARBORS IN THE STATE OF FLORIDA.

REPORT OF CAPTAIN WILLIAM T. ROSSELL, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1885, *WITH OTHER DOCUMENTS RELATING TO THE WORKS.*

IMPROVEMENTS.

1. Saint John's River, Florida.
2. Upper Saint John's River, Florida.
3. Volusia Bar, Florida.
4. Apalachicola Bay, Florida.
5. Tampa Bay, Florida.
6. Suwanee River, Florida.
7. Key West Harbor, Florida.
8. Pears Creek, Florida.
9. Harbor at Cedar Keys, Florida.
10. Manatee River, Florida.
11. Caloosahatchie River, Florida.
12. Apalachicola River, Florida.
13. Withlacoochee River, Florida.
14. Removing sunken vessels or craft obstructing or endangering navigation.

EXAMINATIONS AND SURVEYS.

15. Anclote Harbor, Florida.
16. Wekiva River, Florida.
17. Saint Augustine Harbor, Florida.
18. Amelia River, Florida.
19. Charlotte Harbor, Florida.
20. Mosquito Inlet, Florida.
21. For canal and inland communication from the Saint John's River through Mosquito Lagoon and Indian River to Jupiter Inlet and Lake Worth, Florida.

UNITED STATES ENGINEER OFFICE,
Jacksonville, Fla., July 20, 1885.

GENERAL: I have the honor to transmit herewith my annual reports upon the works of river and harbor improvement under my charge for the fiscal year ending June 30, 1885.

Very respectfully, your obedient servant,

WM. T. ROSSELL,
Captain of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

O 1.

IMPROVEMENT OF SAINT JOHN'S RIVER, FLORIDA.

Operations for improving the channel over the bar at the mouth of the Saint John's River, Florida, during the past fiscal year were carried on from September, 1884, through the year. The work was done under contract, and in accordance with the larger of two projects sub-

mitted to the Chief of Engineers by the officer then in charge, June 30, 1879, and printed as part of Appendix I 7, Annual Report of the Chief of Engineers for 1879.

PROJECT OF IMPROVEMENT.

The plan of improvement essentially consists in the construction of two low jetties, built of riprap stone, supported by a foundation mattress or platform of logs with a mattress hearting wherever found practicable to reduce the cost of the work.

Of the two plans discussed, which differed from each other in magnitude and probable effects, the more comprehensive one has been adopted. This plan provides for the construction of two long jetties, starting from the opposite shores of the entrance, and extending seaward across the bar. It was intended thereby to establish a mid-channel depth of 15 feet at mean low water. The usual available low-water depth over the bar in its unimproved condition was 6 feet, more or less, with a mean rise and fall of tides of about 5 feet. The cost of this project was estimated at $1,306,409.

In order to secure the full benefit of an increased low-water depth on the bar, as contemplated by the project, it will be necessary to improve some defective reaches of Saint John's River between the bar and the city of Jacksonville, the cost of which has been approximately estimated at $120,000.

These additional works are considered to be properly the subject of a special project and appropriation. If it should be finally decided to include them under the general head "Improvement of Saint John's River," the estimate of the cost of the project given above must be comparatively increased.

Since the adoption of the existing plan of improvement of June 30, 1879, four appropriations have been made by Congress for the work, aggregating $525,000. Previously an aggregate sum of $57,476.28 was expended in dredging for the temporary improvement of the bar-channel since 1865.

For making the preliminary surveys and preparing the project, the sum of $2,523.74 was expended.

SUMMARY OF OPERATIONS PRIOR TO JUNE 30, 1884.

North jetty.—The foundation course or apron of this jetty, starting from low-water line of Fort George Island, reaches to a point 1,115 feet from shore, and was laid on a straight course bearing south 73 degrees east. The mattresses, log and brush, or log and poles together, as used for the work, are from 42 feet to 60 feet wide, and from 19 inches to 22½ inches thick. They are held in place by 2,162 cubic yards of riprap stone distributed over them. The seaward end reaches a large shoal known as Ward's Bank.

South jetty.—The foundation course or apron was laid to an aggregate length of 4,813 feet, of which 874 feet form the shore branch, bearing north 46 degrees 45 minutes east. The main line begins at a point 74 feet back from the outer end of the shore branch. For a length of 3,538 feet it follows a straight course bearing north 74 degrees, 54 minutes east. The next length of 328 feet is deflected 1 degree to the east, and the last length of 73 feet 1 degree 47 minutes to the east. The apron is formed of log and brush mattress, varying from 20 to 87 feet in width, and from 10 to 21 inches thick. They are covered with riprap stone to an average thickness of 15 inches.

For a length of 3,209 feet the foundation course was overlaid with a second course of mattresses and stone, the mattresses varying from 45 to 77 feet in width, and the main line was further built up by a third course 1,902 feet long; a fourth course 1,544 feet; a fifth course 1,317 feet; a sixth course 903 feet; a seventh course 127 feet; an eighth course 134 feet; and a ninth course 40 feet.

The mattresses in each course were generally made about 8 feet less in width than those immediately below.

Eight low spur-jetties were constructed, four on each side of the jetty, opposite to each other. They are located at distances of from 500 to 1,800 feet, from the angle of the junction of the main line with the shore branch. These spurs are formed of two courses of mattresses, the lower ones projecting from 81 to 98 feet beyond the edges of the apron of the main line; those laid on the north side are 75 feet wide and those on the south side 100 feet wide. The original foundation course of the main line was widened to arrest the destructive actions of very strong currents, developed alongside of and across the work. A revetment or apron of mattresses, varying in width from 40 to 100 feet, beginning at the low-water mark and extending 2,652 feet, was laid on the south side.

The foundation was still further broadened by placing a revetment or apron on the north side similar to that on the south. This revetment began at the second spur from the shore and extended seaward a distance of 1,703 feet, the width varying from 70 to 100 feet.

Between spurs two and three, upon a length of 300 feet, there seemed to be less stability than in the rest of the jetty. Here the greatest settlement had taken place, and as it had been built up as a wall with steep sides, it was further strengthened by a sort of buttress composed of log mattresses and riprap stone, in all respects similar to the construction of the jetty. This buttress leans or abuts against the jetty for a distance of about 120 feet, parallel to its axis, and is formed of six courses of mattresses, the lower course being 35 feet wide and the top course 14 feet.

For holding the mattress work in place and in building up the south jetty, the amount of riprap stone employed from the beginning of operations to June 30, 1884, aggregated 50,032⅓ cubic yards.

During the same time the total expenditures for both jetties, including outstanding liabilities, were $372,836.04.

	Feet.
Length of north jetty June 30, 1884	1,115
Length of south jetty June 30, 1884	4,813

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1885.

On July 1, 1884, the balance on hand available for work was $2,163.96, and there was appropriated by act of July 5, 1884, a further sum of $150,000, making a total of $152,163.96.

From the commencement of the fiscal year the work was under the charge of Col. Q. A. Gillmore, Corps of Engineers, until he was relieved by me by virtue of Special Orders No. 96, headquarters Corps of Engineers, United States Army, Washington, D. C., August 5, 1884.

On July 1, 1884, the work was idle for lack of funds, and it was not until September 19 that work was actively begun, the intervening time being necessary for advertising the work, making the contract, and getting the plant into working condition.

When the appropriation made by the act of July 5, 1884, became available, proposals were invited for continuing the work of improve-

ment. Two designs for mattresses were described in the specifications, either of which might be used, at the option of the contractor. These designs were as follows:

First design.—This mattress is a raft of round logs not less than 9 inches in diameter at the small end, placed in close contact, side by side, at right angles to the line of the jetty, and firmly held there by transverse pole-binders spiked or bolted to them. There will be placed upon the raft of logs a layer of live-wood brush, sufficient to give 5 inches in thickness in the finished work, secured in place by poles lashed to the binders of the raft. The binders will be smaller logs or poles, not less than 4 inches in depth at the small end, and placed not more than 8 feet apart, and those on the outside will be close to the end of the logs.

Second design.—This mattress will consist of a bottom grillage of poles of an average diameter of at least 6 inches, and not less than 5 inches in diameter at the small end, placed from 4 to 6 feet apart between centers, both longitudinally and transversely, and the lower poles will be parallel to the line of the jetty. The spaces between the upper poles of this bottom grillage will be filled in with similar poles. Upon this raft will be placed two layers of stout hard-wood brush, crossing each other at right angles, each course to be 5 inches thick in the finished jetty, to be followed by a top grillage constructed like the one placed at the bottom. The upper layer of brush will be placed at right angles to the line of jetty. The poles of each grillage will be securely lashed together by suitable wire or rope lashings, and the upper and lower grillages will also be securely lashed together in such a manner as the engineer in charge shall approve, so as to form a strong and compact mattress not less than 16 inches thick in the finished work, the thickness being estimated between the bottom poles of the upper and the top of the lower grillage.

Of four proposals received and opened August 16, 1884, one made by Mr. A. Ames Howlett, of Syracuse, N. Y., was the lowest. He offered to furnish and put in the work mattresses at the price of 75 cents per square yard and riprap stone at the price of $3.10 per cubic yard. With the approval of the Chief of Engineers, a contract was made with Mr. Howlett on September 8, 1884. Operations were carried on on both jetties.

South jetty.—The settlement that had taken place during the previous year was made up by stone alone, the aggregate amount used being 1,500 cubic yards. The jetty from the low-water mark to where the ship-channel crosses it has a height of 2 feet above mean low water. The revetments or aprons on both north and south side were extended to the end of jetty as constructed on July 1; 1884, the width varying on south side from 60 to 70 feet and on north side from 60 to 100 feet.

Beginning at the inshore side of the ship channel a course of mattresses was laid along the axis to raise the jetty for a distance of 1,269 feet. The deflection of the current caused by this work was so great that a new channel cut out north of south jetty and nearly parallel to it, having a depth of 6 feet at mean low water and a width of about 200 feet. The places where this channel formed was at the beginning of the year bare, or nearly so, at low water. As there was a strong tendency for this channel to cut to the southward around the end of the jetty, it was thought advisable not to increase the deflected current until the jetty had been extended.

It was thought that could the mattresses be laid so as to retain the

bottom as it then existed much money would be ultimately saved in raising the jetty.

With this end in view the foundation course was extended seaward on Range 4, bearing north 77 degrees 41 minutes east. This range was extended 327 feet, and the line was then deflected 2 degrees further to the eastward for Range 5 for a distance of 400 feet. The line of the jetty was then successively deflected 2 degrees to the eastward for each new range through Range 8, the length of the ranges being: Range 6, 400 feet; Range 7, 400 feet; and Range 8, 373 feet.

The direction of the axis being at present north 85 degrees 41 minutes east, to give a sufficiently broad base to hold the bottom, the width of these mattresses were made from 110 to 120 feet, the depth of the water in which they were set varying from 12 feet to 2 feet. These mattresses were held in place by riprap stone to a thickness of 1 foot. The aggregate amount of stone placed on the south jetty during the fiscal year was 16,312.16 cubic yards, and 52,037.55 square yards of mats laid.

North jetty.—The north jetty, when begun, extended from low water seaward. During the time of idleness a slough had cut out behind the jetty, and much anxiety has been felt for the beach. Therefore this jetty has been extended shoreward to the high-water mark, a distance of 905 feet, the mattresses varying in width from 50 to 65 feet. While the work was progressing on the south jetty a slough cut out across the line of the north jetty, as proposed, and with the desire of stopping this, the north jetty has been extended seaward a distance of 987 feet. The mattresses have a width of 100 feet, and are covered with riprap stone to a depth of 9 inches. The aggregate amount of stone used on this jetty during the year is 3,699.64 cubic yards, and 16,712.22 square yards of mats were laid. The depth of water in which this work lies varies from 0 to 9 feet at mean low water. The axis of this jetty is thus far laid on a single range, bearing south 73 degrees east.

During the year the contractor has furnished and put into the work 68,749.77 square yards of mattresses and 20,011.80 cubic yards of riprap stone.

	Feet.
Length of north jetty, June 30, 1885	3,007
Length of south jetty, June 30, 1885	6,713

OPERATIONS CONTEMPLATED DURING THE PRESENT FISCAL YEAR.

With the balance of $30,925.95, on hand July 1, 1885, it is proposed to continue the extension of the north jetty.

EFFECTS OF THE WORKS AND CHANGES GENERALLY.

As was mentioned in the last annual report, the south jetty was forcing a portion of the current to seek an outlet between the proposed positions of the two jetties. On beginning work, during the past fiscal year, a course of mattresses covered with riprap stone was laid on the portion of the jetty where the sailing-line crosses it. This course was extended seaward. This additional height caused such an increase in the deflected current that a channel scoured out parallel to the south jetty and north of it. As there was a strong tendency in this current to cut round the end of the jetty to the southward it was deemed best to extend the foundation course seaward rather than increase the height. It was thought that by this means the bottom might be held and the ultimate cost of the work lessened. The channel followed the jetty as

it was extended seaward, remaining parallel to it, and to-day there exists a channel 400 feet wide north of the south jetty, with a depth of more than 6 feet at mean low water out to sea. The depth across the bar along the sailing-line is 7 feet at mean low water. This is the most notable effect produced by the work during the year.

On June 30, 1884, where this channel now exists was almost bare at low water. While this work was being done the north beach near the shore end of the north jetty was badly washed. This erosion had been going on slowly for the past three years, but, owing to the small appropriations and the critical condition of the south jetty, due to delays in the work, there had been no time when the shore connection of the north jetty could be completed. After having extended the south jetty over the crest of the bar I felt that, in view of the failure of the river and harbor bill for 1885, that it would not be safe to leave the north jetty any longer. I therefore extended the north jetty to the high-water mark; the result, a sanding up of the small slough or channel that had existed here.

The water, cut off from this channel, began cutting a new line to the sea around the sea-end of the north jetty, and it was deemed best to extend the foundation course seaward to hold the bottom and save ultimate expense.

One of the causes of the settling in the south jetty was the wash near the jetty, due to the parallel and cross currents, and to counteract this aprons or revetments were laid on both sides. In order to watch this scour, I had taken, every month, four lines of soundings parallel to the south jetty; of these, two were north of the axis and distant from it 50 and 150 feet, respectively, the other two in the same relative positions on the south side. Owing to the bad weather and the interference of the contract work several months were missed.

Those that were taken I have had plotted, and by a reference to them it may be seen that no dangerous scour existed during the past fiscal year. The two jetties, as far as constructed, are in good condition. The high-water line on the south beach, near the shore end of the south jetty, has built out more than 400 feet in places.

From the new position of Ward's bank it seems probable that could the gap, left in the south jetty for commerce, be filled up, that it would extend across the present channel, and that the south jetty would become a sand-bank, with a solid hearting. Could the north jetty be built to protect the channel and prevent its shifting to the north, it seems probable that the channel will form without any aid from dredging.

In conclusion I would state that in my opinion the work is in a very promising state.

NECESSITY OF AN EARLY APPROPRIATION.

The channel across the bar at the mouth of the Saint John's River has always been subject to great changes in position and depth. The sailing line has shifted from year to year until it has, at sometime, occupied nearly every position through an arc of nearly 180 degrees. The depth varies from 10 feet to 15 feet at high water. These changes are due to the weather. The sand forming the bars moves easily, and a single storm may make great changes in the position and extent of the channels and shoals.

The object of the improvement is to form and retain a permanent channel of sufficient width and depth to accommodate the commerce which will seek the port. This is to be done by building artificial banks or

shoals that will be permanent and thus render the channel so also. The position of these artificial shoals or banks (jetties) being so fixed as to cause the flow of water to make and retain the channel of the required width and depth.

In building these jetties on the shifting bottom, great care must be taken to meet the problems as they arise. Any work in an unfinished condition is much more liable to damage than a finished one. But the results of a severe storm, if met at once, will be inexpensive compared to those which may come from slight causes acting unchecked through a considerable time. It seems almost an axiom that in a work of this magnitude and importance, and one that is necessarily so exposed during its construction, that there should at all times be a sufficient amount of money on hand to meet any injuries that may occur.

During the progress of the work, from its commencement on December 14, 1880, up to the present time it has been idle, through lack of money, for more than a year.

The damage caused by these delays has materially increased the cost of the work. On this subject I quote from the last Annual Report made by Col. Q. A. Gillmore on this work:

> The precarious condition in which the south jetty continued during a large part of the last calendar year, and the serious damage which it received, would have been avoided if means for a continuous and vigorous prosecution of the work had been provided from the outset. As it is, several hundred thousand dollars have been added thereby to the final cost of the improvement.

Again, without funds to carry on the work, a gap must be left in the south jetty to give accommodation to commerce. Yet even with this gap, a new channel has opened and gives the greatest promise, could the work be pushed continuously. Should this gap be closed, with no money to rely on for the future, an accident to the work would be most disastrous to the commerce of the port. I would most earnestly recommend, in the interests of economy and of the success of the work, that an early appropriation be made to enable operations to be resumed during the coming winter.

It is proposed to use the appropriation asked for in extending the north jetty seaward and raising it, and in completing the south jetty.

This improvement is located in the collection district of Saint John's. Jacksonville is the nearest port of entry. Nearest light-house is Saint John's River Light. Nearest fort is Fort Clinch. Amount of duties collected in fiscal year 1885, $473.86.

The following appropriations have been made for this work since the present project of improvement was adopted:

By act of Congress approved June 14, 1880	$125,000
By act of Congress approved March 3, 1881	100,000
By act of Congress passed August 2, 1882	150,000
By act of Congress approved July 5, 1884	150,000
Total	525,000

The total expenditures to June 30, 1885, including outstanding liabilities, were $494,074.05.

The following papers accompany this report:

1. Map of mouth of river.
2. Plan and profile of south jetty.
3. Plan and profile of north jetty.
4. Comparative profiles parallel to south jetty.
5. Report of Inspector of Construction L. L. Lomax.

Money statement.

July 1, 1884, amount available		$2,163 96
Amount appropriated by act approved July 5, 1884		150,000 00
		152,163 96
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$92,451 77	
July 1, 1885, outstanding liabilities	28,786 24	
		121,238 01
July 1, 1885, amount available		30,925 95
Amount (estimated) required for completion of existing project		781,409 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		600,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

Abstract of proposals for construction of jetties at mouth of Saint John's River, Florida, opened August 16, 1885.

No.	Names of bidders.	Mattresses, per square yard.	Riprap stone, per cubic yard.
1	John F. Gaynor	$0 69	$3 59
2	Alfred Ames Howlett	75	3 10
3	Henry S. Ely	65	4 00
4	Wm. H. Brown	77	4 48

Contract awarded to Alfred Ames Howlett, dated September 1, 1884; commenced September 19, to be completed October 15, 1884.

REPORT OF MR. L. L. LOMAX, INSPECTOR.

FORT GEORGE, FLA., *July* 2, 1885.

SIR: Pursuant to instructions, I have the honor to make the following report with reference to manner of building mats and of conducting the work for the Saint John's River jetties.

THE MANNER OF BUILDING MATS.

The mat camp is 12 miles above, on the river, and employs from twenty-five to thirty hands and twenty-four mules.

The dimension of the mats being given from the chief office to the mat inspector, he sees that the mats are built according to the specifications. It requires seven men to build the mat, four hands to cut logs, ten teamsters, and five men to cut brush and put on the mat.

The logs are hauled to the bank and inspected, and then rolled in the water, floated to position, and held in place for spiking by cant-hooks, the spikes used being 12-inch. Two masts are strongly braced on the mat, with buoy-lines and buoys made fast at the foot of each mast. The mats are numbered on the masts and also on the buoys. It requires three days to make a mat 100 by 100 feet.

The brush is held on the mat by slight binders tied down with small rope, at least 5 inches of green-wood brush being required on the mat.

CONTRACTOR'S PLANT.

The plant consists of one large tug, used to tow the mats from the camp to the work; one small tug, used to tow the logs from the different landings to the camp; five large lighters, from 85 feet to 100 feet long and 22 feet wide, with capstans, and two smaller scows (these lighters are strongly decked over and thoroughly braced); two yawl-boats, for four oars; one hoisting engine; three large iron buckets; four large anchors and several kedge anchors, weighing from 450 to 600 pounds; rope; spars for anchor; buoys; and the usual small tools for carrying on a work.

Report for 1885.

Geological Survey

UNLOADING VESSELS AND PILING STONE.

The vessels are brought alongside of the dock, upon which is placed the hoisting engine. The scows are placed on the outer side of the vessel, lines being so rigged that the tubs can be dumped on the scows. Six men are placed in the hold to fill the tubs, one at the guy-rope to guide the tub when hoisted, and five on the scow to pile the stone.

The stone is regularly piled in such a manner that it can be conveniently measured, the height of the pile being generally 2.5 feet, the scow measuring from 112 to 115 yards. Two of the scows can be readily loaded in a day. The dirt in the vessel is placed in a separate pile from the stone, and not measured or taken into account.

MAKING UP THE TOW.

The mat is made fast to two scows, one on each side, by bridle lines leading over the timber heads on the side of the scow and under and around a log of the mat, care being taken that the lines will readily reeve on the mat when the mat is to be lowered down. A mat of 100 feet requires four bridle lines on each scow. The scows, one on each side of the mat, are pulled close to the mat by placing the lines on the capstans.

SETTING THE MAT.

First method.—The mats are invariably set on an ebb tide. When nearing the line of the work the tow is turned heading the tide, or is allowed to drop with the tide, that the breast lines may be run from upper scow to the buoys anchored for the purpose. (See Diagram 1, method.*) These lines and others are run in yawl-boats. The anchors are placed above the work and parallel to the axis. The line from the tow-boat is now cast off. By slackening the breast lines the mat is allowed to drop down near the range, it being of the greatest importance that the mat be kept parallel to the line of the work.

Other lines are now run as follows: A line to buoy and anchor on the line of the work to act as a stern line. Lines from the head of each scow to two buoys made fast on a mat previously set, to serve as head lines to bring the mat close to the head of work already completed; two kedge anchors are now placed below the work, and breast lines run from the second scow; the last two anchors being placed in a position below the work corresponding to the two breast anchors above.

The mat is now slackened down on range, the breast lines being used to move an end on the mat bodily, the stern line to keep the mat off of the work, the head lines to draw the mat to the work.

The tide having slackened, and the mat in position, stone is placed on in sufficient quantity to stretch the bridle lines equally. The inspector having reported the mats to be on range, the mat is lowered a few feet and more stone placed. If the mat has moved off range in lowering, its position is rectified by placing the proper line on capstan. This plan is pursued, lowering and rectifying, until the mat is near the bottom, when all bridle lines are cast off and the mat settles to its position. Great care is taken to slack off the bridle lines equally or the mat may cant in lowering and shoot far off the range.

The mat being on the bottom, the stone is distributed by heaving the two scows on top of the mat. By placing the several lines on the capstan, the position of the scows can be changed as directed.

The above method can be used in any case where the mat is not more than 10 feet longer than the scows and where it is not very rough. The mats now being set are 100 feet by 100 feet.

It requires sixteen hands to set a mat as above described, distributed as follows:

Five hands for each yawl-boat to run lines. Three on each scow to attend lines. There is also a mat-setter to take charge of the work. All hands distribute stone. The time required to set and stone a mat, if there is no impediment is from two and half to three hours.

It has been found that the above method is the most exact of any used.

Second method.—This method was used in the breakers and with mats 120 feet by 60 feet, the greater dimension (120 feet) being perpendicular to the axis of the work. The scows were attached to the mat by two bridle lines passing over the head of each scow, the length of the scow being perpendicular to the axis (see diagram*), one large scow and one smaller one being used; the small scow having only enough stone to sink one end of the mat and not hauled on it.

The disadvantages of the above method are, viz: To move either end of the mat, the entire length of mat and scow have to be moved, requiring much heaving and loss of time at the capstan. If the mat drops below the end of the work, the heaving has to be done against the tide. One end of the mat being on the bottom, in case a line parting or an anchor dragging, it is impossible to bring the mat back to the range

*Omitted.

to prevent a lap in the work. One end of the mat being afloat and in the breakers, the mat is weakened by the sea and liable to break up. Most of the stone has to be hauled over the head of the scow, taking much time, and cannot be so evenly distributed. It is impossible to save the masts or prevent a lap in case the tide commenced to run flood. It requires from four to five hours to set and stone the mat. In deep water or an uneven bottom, the mat could not be placed on range accurately. The only advantage being that the breaker does not have the broad side of the scow to act upon, thereby driving it on and breaking up the mat. A sufficient amount of stone is kept back from the mats, so that in case many vessels arrive in port together, a place can be made for it, thereby saving demurrage.

The work of the present contract commenced on September 19, 1884.

NUMBER OF DAYS IN WHICH STONE WAS PUT ON OR MATS SET.

Date.	Days.	Date.	Days.
Sept., 1884	9	Feb., 1885	7
Oct., 1884	16	Mar., 1885	15
Nov., 1884	17	Apr., 1885	14
Dec., 1884	13	May, 1885	22
Jan., 1885	14	June, 1885	20

THE CONDITION OF THE WORK.

South jetty.—Most of this work consisted of laying the first course of mats, extending the jetty already partially laid.

The work was done during the stormy season in winter, and the contractor met with many difficulties. Most of the work was in and on the edge of the breakers.

The general range of the work is good. Many of the mats lapped more than required, and the lap had to be cut away, being a loss to the contractor. Several mats were also broken up and lost. On two occasions stone had to be thrown off and abandoned to save the scows.

The work is mostly bare at low water and presents a good appearance, the stone having been distributed by hand and the logs cut off. No mats have settled, and the work on the outer end is sanding over.

With but little work the jetty can be brought up to low water.

North jetty.—This work presents a good appearance. The mats are on range, with but one exception, which was caused by attempting to set the mat on a flood tide.

I would state, in conclusion, that the contractor has made every exertion to do his work faithfully.

The effect of extending the jetties has been such that the most skeptical are now thoroughly convinced of the ultimate success of the work.

Respectfully,

L. L. LOMAX,
Inspector of Construction.

Capt. WILLIAM T. ROSSELL,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

Arrivals and clearances of vessels and commerce at Jacksonville, Fla., from January 1, 1878, *to June* 30, 1885.

ARRIVED.

Years.	Coastwise.			Foreign ports.						Total.		
				Americal vessels.			Foreign vessels.					
	Vessels.	Tonnage.	Crew.	Vessels.	Tonnage.	Crew.	Vessels.	Tonnage.	Crew.	Vessels.	Tonnage.	Crew.
1878	325	92, 267	2, 917	19	2, 979	118	10	653	56	264	95, 899	3, 091
1879	335	170, 872	5, 172	17	3, 008	108	23	12, 948	558	375	186, 829	5, 838
1880	353	161, 039	4, 487	21	4, 019	136	9	673	57	383	165, 731	4, 680
1881	408	150, 430	4, 169	19	3, 161	134	10	665	62	437	154, 256	4, 365
1882	376	116, 829	3, 149	11	5, 183	155	22	1, 501	140	409	123, 513	3, 444
1883	289	74, 889	2, 169	5	1, 129	34	15	1, 062	97	309	77, 080	2, 300
1884	328	114, 919	4, 328	3	566	20	17	1, 412	117	348	116, 897	4, 465

Arrivals and clearances of vessels and commerce at Jacksonville, Fla., &c.—Continued.

CLEARED.

Years.	Coastwise.			Foreign ports.						Total.		
				American vessels.			Foreign vessels.					
	Vessels.	Tonnage.	Crew.	Vessels.	Tonnage.	Crew.	Vessels.	Tonnage.	Crew.	Vessels.	Tonnage.	Crew.
1878	245	94, 732	5, 838	34	6, 076	214	10	678	61	289	101, 486	6, 113
1879	335	169, 949	5, 077	34	5, 839	211	21	12, 908	559	390	188, 696	5, 847
1880	363	158, 733	4, 346	45	13, 526	428	10	716	72	418	172, 975	4, 846
1881	420	150, 494	4, 281	26	5, 547	192	11	950	76	457	156, 001	4, 540
1882	365	114, 741	2, 892	30	8, 687	277	22	1, 470	163	417	124, 898	3, 332
1883	258	65, 450	1, 919	19	1, 825	130	14	1, 051	92	291	68, 326	2, 141
1884	295	103, 737	4, 091	19	4, 397	126	17	1, 411	121	331	109, 545	4, 338

Commerce.

Years.	Value of exports.	Value of imports.	Duties collected.
1878	$74, 035 47	$1, 363 27	$181 52
1879	92, 890 84	15, 309 26	771 21
1880	94, 680 00	888 40	98 91
1881	62, 265 07	2, 380 08	230 03
1882	68, 583 84	12, 542 51	4, 701 26
1883	47, 920 45	3, 805 23	466 99
1884	54, 071 32	35, 375 54	473 86

O 2.

IMPROVEMENT OF THE UPPER SAINT JOHN'S RIVER, FLORIDA.

By the river and harbor act, approved July 5, 1884, the sum of $5,000 was appropriated for improving the Upper Saint John's River, Florida. This is the first appropriation ever made by Congress for this work.

The part of the Saint John's River referred to in the act is presumed to be that portion extending from Lake Monroe to the head of Lake George, a distance by river of about 45 miles. An examination of this section was made in the early part of the year 1879, report of which, dated July 16, 1879, with a project of improvemnnt, is printed as Appendix I 9, Annual Report of the Chief of Engineers for 1879. It was stated in that report that the stream, although very crooked, is of ample depth for any class of vessels adapted to the navigation of the Upper Saint John's River, and that the only gain to be secured by cut-offs is strictly in distance, and was suggested to confine the work of improvement to cutting off the four most prominent bends, located as follows:

1. A bend three-fourths of a mile above Old Town, 25 miles below Lake Monroe.

2. Two bends about 2 miles below Manuel's Landing, or 7½ miles below Lake Monroe.

3. A bend at Manuel's Landing, 5½ miles below Lake Monroe.

The results of a later examination of the same section of the river, made in conformity to a provision in the river and harbor act passed August 2, 1882, did not differ from the conclusions previously reached.

In pursuance to instructions from the Department there was submitted under date of October 5, 1883, another report, and with it revised plans and estimates of cost of improvement.

The width of the river at the bends named varies from 130 to 150 feet, and in the reaches connecting them from 150 to 200 feet. The banks and adjoining ground average 4 feet above the water-surface at low-river stage. The plan of improvement contemplates cut-offs 100 feet wide at the bottom side slopes 1 on 1, and a low-river depth in the cuts of 6 feet. This depth was adopted as being the maximum low-river depth at the shoalest places between Little Lake George, 20 miles below the head of Lake George and Lake Monroe.

Two estimates were submitted, one for straight cut-offs, and the other for curved cut-offs, the curves being quite easy so as to offer no obstruction to navigation. The work would principally consist in dredging, but a few light closure dams will have to be built and some grubbing done. The cost of improving the four bends is estimated at $43,000 for straight cut-offs, and at $38,800 for curved cut-offs. It is proposed to adopt the latter plan in carrying out the improvement.

The appropriation available during the past fical year being small, it was proposed to begin operations by opening the shortest cut, that at Old Town. With this end in view proposals were invited to be opened on the 24th day of October, 1884. In answer to this advertisement no bids were received.

Under these circumstances, with the approval of the Chief of Engineers, it was decided to wait until further appropriations are made before beginning the work.

The area of country that will be benefited by this improvement is estimated at 26,000 square miles, with a population in 1879 of 40,000 and land under cultivation that year valued at $7,500,000.

Three regular lines of steamers make trips through this part of the river. During the winter months there are probably three steamers each way daily, and during the summer one daily.

It is proposed to use the balance available and the appropriation asked for in making the cut-offs in accordance with project.

This work is located in the collection district of Saint John's; Jacksonville is the nearest port of entry; nearest light-house is Dame's Point Light; nearest fort is Fort Marion. Amount of duties collected in fiscal year $473.86.

Money statement.

Amount appropriated by act approved July 5, 1884	$5,000 00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	20 79
July 1, 1885, amount available	4,979 21
Amount (estimated) required for completion of existing project	33,800 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	33,800 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

O 3.

IMPROVEMENT OF VOLUSIA BAR, FLORIDA.

Operations for improving Volusia Bar, Florida, have been carried on at intervals since December, 1880. Four appropriations have thus far been made by Congress for its improvement, previous to the current fiscal year, aggregating $17,500.

Volusia Bar is located at the south end or head of Lake George, about 162 miles by river from the mouth of the Saint John's River, at the point where the water of the river flows into the lake.

An examination of Volusia Bar with a view to its improvement was made in March, 1879. A report thereon, dated July 16, 1879, with plan of improvement, is printed as Appendix I 9, Annual Report of the Chief of Engineers for 1879.

PROJECT OF IMPROVEMENT.

The original project comprised the construction of two jetties, designed to establish a channel depth on the bar of 6 feet, while previously low-river depth has frequently not exceeded $3\frac{1}{2}$ to $4\frac{1}{2}$ feet.

On the supposition that the jetties would extend beyond the bar until reaching 6 feet of water, with their outer ends 200 or 250 feet apart, and their crests at the level of summer low water, the cost of the work was estimated at $15,000.

As stated in annual report on this work for 1883, this estimate should be increased to secure a low-river channel of 6 feet depth, and to prevent the formation of a new bar beyond the ends of the jetties. The reasons are that the jetties must be made longer than first contemplated, and be raised higher. A number of fender-piles were driven, and more will be needed, on either side of the bar channel, to prevent steamboats from running foul of the jetties, and compel them to follow continually the same course in crossing the bar. These piles were not included in the original project. The width between the jetties on the bar had been made tentatively about 240 feet; it is now deemed expedient to reduce this distance somewhat by spurs built from either side of the jetties, or from one jetty only, as the case may be, to increase the strength of the current. The expenses were also undoubtedly increased by the fact that the work had to be done in a fragmentary manner, since the amount asked for was not furnished in one sum, but in four small appropriations.

For the extra work it is estimated that $7,500, in addition to the appropriations made, would be necessary, so that some dredging can be done on the bar, while the jetties are being extended, to establish at once the required depth which said jetties, when completed, will probably maintain for a long period. It is estimated that about 12,000 cubic yards of material should be removed by dredging.

OPERATIONS TO JUNE 30, 1884.

The west jetty, built on a straight line bearing north 25 degrees west, has reached a length of 2,206 feet from shore. For the greater part it is formed of a single course of pole and brush mattresses from 6 to 12 feet wide, loaded with broken stone. A second course of 6-foot mattresses covers 159 linear feet of the outer portion of the jetty.

The shore end of the east jetty is about 2,400 feet east of the west jetty. It is built on lines by which it gradually converges toward the latter work in approaching the bar. Its aggregate length is at present 3,459 feet. From the shore it extends 1,836 linear feet on a range bearing north 76 degrees west; the next length of 1,100 feet bears north 63 degrees west; and the remainder, which is located upon the bar, runs about parallel to the opposite part of the west jetty, and 240 feet from it. It generally consists of a single course of mattresses from 6 to 12 feet wide, covered with riprap stone, except for 247 feet length at the bar, where a second course was put on.

One hundred and fifty fender-piles were driven on the bar, nearly all in clusters of three and four, in two rows, 75 feet apart. Each row extends over a length exceeding 800 feet, and runs about parallel to the west jetty. The row nearest to that work is about 100 feet from it. At the beginning of the past fiscal year July 1, 1884, all of these piles had been broken or knocked down. In this condition they formed a serious obstruction to navigation.

OPERATIONS DURING THE PAST FISCAL YEAR.

On July 1, 1884, the balance on hand available for work was $430.96, and there was appropriated by act of July 5, 1884, a further sum of $2,000, making a total of $2,430.96.

From the commencement of the fiscal year the work was under the charge of Col. Q. A. Gillmore, Corps of Engineers, until he was relieved by me by virtue of Special Orders No. 96, headquarters Corps of Engineers, United States Army, Washington, D. C., August 5, 1884.

On July 1, 1884, the work was idle for lack of funds, and it was not until January 5, 1885, that work was actively begun, the intervening time being necessary for advertising the work, making the contract, and getting the plant into working order.

The operations consisted in removing the broken piling, driving new rows of guide-piling, and placing 75 cubic yards of riprap stone on the low places of the east jetty.

All work was done under contract with Messrs. Hopkins and LeBaron, approved by the Chief of Engineers December 6, 1884. The work consisted in removing nineteen broken piles, furnishing and driving one hundred and fifty-eight piles in clusters, chaining these clusters with 5,981.54 pounds of chain and furnishing and placing 75 cubic yards of riprap stone on east jetty.

THE EFFECTS OF THE WORK AND CONDITION GENERALLY.

Althoughsettlement has taken place along both jetties, they are still in good condition and have sanded up along their whole length.

The rows of guide-piles heretofore driven have only lasted for about one year. They have been knocked down or broken by passing steamers. I have this year increased the width between rows from 75 to 100 feet, increased the diameter of the piles from 10 inches to 12 inches, and the depth to which they are driven from 10 feet to 12 feet. Heretofore the clusters have been driven at equal distances from each other. This year I have made these distances vary, placing them nearer together where most likely to be struck. It is propable, however, that some piles will have to be replaced during the next fiscal year.

Since the work of improvement was commenced, the following appropriations have been made:

By act of Congress approved June 14, 1880	$5,000
By act of Congress approved March 3, 1881	5,500
By act of Congress passed August 2, 1882	5,000
By act of Congress approved July 5, 1884	2,000
Total	17,500

Of this amount the sum of $17,337.51 has been expended to June 30, 1885.

The balance available and appropriation asked for are to be used in

raising and extending the jetties, in keeping the fender-piles up, and in dredging if necessary.

This work is located in the collection district of Saint John's. Jacksonville is the nearest port of entry. Nearest light-house is Dame's Point Light. Nearest fort is Fort Marion. Amount of revenue collected in 1885, $473.86.

Report of Assistant Engineer A. W. Barber is submitted herewith.

Money statement.

July 1, 1884, amount available	$430 96
Amount appropriated by act approved July 5, 1884	2,000 00
	2,430 96
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	2,268 47
July 1, 1885, amount available	162 49
Amount (estimated) required for completion of existing project	7,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	7,500 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for improving Volusia Bar, Florida, opened October 24, 1884.

PILES TO BE DRIVEN.

No.	Names of bidders.	Estimated number of.	Price.	Total.
1	F. A. L. Cassidy	150	$6 00	$900 00
2	Hopkins & Le Baron*	150	5 00	750 00
3	George A. De Cottes	150	6 50	975 00

BROKEN PILES TO BE REMOVED.

1	F. A. L. Cassidy	75	$5 00	$375 00
2	Hopkins & Le Baron*	75	5 00	375 00
3	George A. De Cottes	75	5 00	300 00

CUBIC YARDS OF STONE REQUIRED.

1	F. A. L. Cassidy	75	$5 75	$431 25
2	Hopkins & Le Baron*	75	6 00	450 00
3	George A. De Cottes	75	6 90	517 50

POUNDS OF CHAIN REQUIRED.

1	F. A. L. Cassidy	3,300	$0 06	$198 00
2	Hopkins & Le Baron*	3,300	09	297 00
3	George A. De Cottes	3,300	07	231 00

No.	Names of bidders.	Aggregate.	Commenced work.	Complete work.
1	F. A. L. Cassidy	$1,904 25	November 5, 1884.	Within six weeks.
2	Hopkins & Le Baron*	1,872 00	Not stated.	Not stated.
3	George A. De Cottes	2,023 50	Not stated.	Not stated.

* Lowest bid.

Contract awarded to Messrs. Hopkins & Le Baron, with approval of the Chief of Engineers. Operations commenced January 5, 1885, and were completed February 20, 1885.

RRPORT OF MR. A. W. BARBER, ASSISTANT ENGINEER.

JACKSONVILLE, FLA., *June* 30, 1885.

CAPTAIN: I have the honor to submit the following report of work done at Volusia Bar, Florida, during the fiscal year ending June 30, 1885:

On November 25, 1884, a contract was entered into with Messrs. Hopkins & Le Baron, of Jacksonville, Fla., and approved by the Chief of Engineers United States Army on December 6, 1884.

Under orders from you the work was staked out as follows: Commencing at a point opposite the second angle in the east jetty, and driving two rows of piling just 100 feet apart as far as the end of the west jetty, making a slight angle at each end; the angle on the west line of piles at the south end with a bell toward the end of the west jetty; the angle on the east line of piles at the north end, with bell toward east jetty, as shown on accompanying sketch.*

The contractor commenced work on January 5, 1885, and finished February 20, 1885. It resulted in driving two lines of piling just 100 feet apart from the second angle in the east jetty as far as the end of the west jetty. They are driven 12 feet into the ground, and placed in clusters of from three to six piles in each cluster, and very firm, 15 feet to 60 feet apart, the piles being closest where the track of the steamer would intersect. They are securely fastened together with chains. There were also placed on the low places on the east jetty 75 cubic yards of stone.

Pounds of chain used	5,981.54
Broken piles removed	19
Piles driven	158
Cubic yards of stone placed on jetty	75

I have reasons to believe that the piling driven will remain, as they have stood through one season, when the greatest number of boats were on the river, and now remain good, with the exception of one cluster slightly bent out of line.

Very respectfully, your obedient servant,

A. W. BARBER,
Assistant Engineer.

Capt. WM. T. ROSSELL,
Corps of Engineers, U. S. A.

O 4.

IMPROVEMENT OF APALACHICOLA BAY, FLORIDA.

Operations for the improvement of this bay were carried on during the past fiscal year, in accordance with the project submitted to the Chief of Engineers, and published in the Annual Report for 1879, pages 823 and 824.

A bar existed at the mouth of the river, extending from one half mile below the town of Apalachicola, Fla., to the lower anchorage. The minimum depth of water over this bar was 3½ feet.

The plan proposed and adopted was the deepening of the channel to 11 feet, with a width of 100 feet.

The work was to be done under contract by dredging, at an estimated cost of $100,000.

The following appropriations have been made:

By act approved June 14, 1880	$10,000
By act approved March 3, 1881	10,000
By act passed August 2, 1882	25,000
By act approved July 5, 1884	10,000
Total	*55,000

* Sketch omitted.

OPERATIONS PRIOR TO JUNE 30, 1884.

The contract under the first appropriation was awarded to W. A. Alexander, at 43¾ cents per cubic yard.

The second contract was awarded to John Tomlinson at 29½ cents per cubic yard.

The third contract was awarded to John Maguire at 22½ cents per cubic yard.

Under these contracts a channel was dredged 5,200 feet long and 75 feet wide, and a continuation 860 feet long and 60 feet wide, with an average depth of 9½ feet at low tide.

OPERATIONS DURING THE PAST FISCAL YEAR.

On July 1, 1884, there were no funds available for this work. By the river and harbor act of July 5, 1884, $10,000 were appropriated.

From the commencement of the fiscal year the work was under the charge of Maj. A. N. Damrell, Corps of Engineers, until he was relieved by me, by virtue of Special Order No. 96, headquarters Corps of Engineers, United States Army, Washington, D. C., August 5, 1884.

An examination of the dredged channel was made and it was found to have partially filled up, leaving an available channel way from the wharves of the city to the anchorage only 6 feet deep. In places the old dredged channel was found to have held its depth well, and in others to have been entirely obliterated.

This work was advertised and bids opened on December 10, 1884; as all the bids received were considered too high they were rejected by the authority of the Chief of Engineers, and new bids were called for by circular letter.

These bids were opened on January 10, 1885.

A contract was then made with Mr. S. N. Kimball to dredge the channel at 29⅓ cents per cubic yards. Contract approved February 3, 1885.

Under this contract work was begun on February 25, 1885, and finished April 30, 1885, resulting in dredging a channel-way 4,177.7 feet long 60 feet wide to a depth of 9.5 feet at mean low water.

It is unfortunate that the money available was not sufficient to make the cut completely through to deep water.

The material removed was in some places soft silt mixed with twigs and apparently some sawdust. In other places the material was hard and compact.

In the first case apparently the material was of quite recent deposit, and in the other was the original bed of the bay.

As to the permanency of the channel, should it be dredged through, there is doubt; but as to its lack of permanency when only partially dug, there seems to be none.

To increase the flow through the channel and add to the scouring effect of the water, it would be desirable to build a dam across the false channel in the position shown on the accompanying map.

By current measurements made during ebb tide it was found that about 20 per cent. of the water found its way into the bar through this channel. Hence its closure would increase the flow through the main channel about 25 per cent.

The balance available and the appropriation asked is to be used in extending, widening, and deepening the cut by dredging, under the project.

Apalachicola Bay is in the collection district of Apalachicola Bay, which is the nearest port of entry. Nearest light-house, Cape Saint George Light. Nearest fort, defenses of Pensacola, Fla. Amount of revenue collected during fiscal year, $2,477.17.

The following papers accompany this report:

1. Map of Apalachicola Bay, showing channel dredged.
2. Report of Assistant Engineer A. W. Barber.

Money statement.

Amount appropriated by act approved July 5, 1884	$10,000 00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	9,284 37
July 1, 1885, amount available	715 63
Amount (estimated) required for completion of existing project	45,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	45,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for improving Apalachicola Bay, Florida, opened December 4, 1884.

No.	Names of bidders.	Dredging per cubic yard.	Commence.	Complete.
		Cents.		
1	Rittenhouse Moore	45	Not stated	Not stated.
2	S. N. Kimball	$39\frac{3}{10}$	do	Do.

These prices being considered high, it was recommended that the bids be rejected, which recommendation was approved.

Abstract of proposals for improving Apalachicola Bay, Florida, opened January 10, 1885.

No.	Names of bidders.	Dredging per cubic yard.	Commence.	Complete.
		Cents.		
1	J. E. Slaughter	$34\frac{74}{100}$	Not stated	Not stated.
2	John Maguire	36	do	One year from commencement.
3	S. N. Kimball	*$29\frac{1}{3}$	do	Not statsd.

*Lowest bid.

Contract awarded to S. N. Kimball. Operations commenced February 25, 1885. Contract completed April 30, 1885.

REPORT OF MR. A. W. BARBER, ASSISTANT ENGINEER.

JACKSONVILLE, FLA., *June* 30, 1885.

CAPTAIN: I have the honor to submit the following report of work done at Apalachicola Bay, Florida:

In pursuance of your order of February 1, 1885, to proceed to Apalachicola and survey the channel across the bar at that place, also stake out sufficient work for the contractor, I left Jacksonville on the 2d of February and arrived in Apalachicola February 5, 1885.

I immediately organized a corps, and with the assistance of Mr. John R. Williams, the inspector, proceeded to survey the channel. A more unfavorable time for the

work could not have been selected, for out of eighteen days there were only four that were suitable for work on account of the stormy weather and heavy gales.

The large number of rafts of lumber going out for shipment at this season of the year made it impossible to keep any stakes standing, and with your permission I had five clusters, of three piles each, driven nearly equal distance apart, and 20 feet east of the east edge of the channel, making a permanent location of the channel and at the same time aiding the pilots in navigating it.

I find in the Annual Report of the Chief of Engineers for 1884, pages 1175 and 1176, "that the total length of the cut was about 6,060 feet, 5,200 feet of which has a width of 75 feet, and the remainder, 860 feet, was 60 feet, with an average depth of 9½ feet at low water." Upon examination I find that this channel has filled and widened, and now has an average width of 100 feet with a depth varying from 9½ feet to 6.3 feet. I believe the filling and widening of this cut is largely due to the tug-boats running into the banks and churning the sides of the cut; this was caused from the want of any definite marking of the channel. I hope that the piles driven will in a measure obviate this, and enable them to keep in the channel, thereby aiding in keeping the cut open. But there are natural reasons why this channel should gradually fill as long as it is not cut through to deep water. About 10 miles above Apalachicola the river divides and empties into Apalachicola Bay through two channels, one known as the Saint Mark's River and the other as the Apalachicola.

The bay is from 20 to 25 miles wide, with the proposed channel crossing it nearly in the middle. The volume of water that empties into this bay is about equal from the two channels. The Saint Mark's follows the eastern edge of the bay while the Apalachicola runs through the proposed channel. With a brisk northeasterly or easterly wind there is nearly as strong a current across the proposed channel as through it.

Again, at Apalachicola there is another outlet between Towhead Island and the mainland, on the east side of the river. Fully 20 per cent. of the volume of water that comes down the Apalachicola River passes through this opening. This channel could be closed with a pile-dam at a cost of ———.

I believe, with all the natural disadvantages, could an appropriation sufficient to dredge the cut 100 feet wide through from the 11-foot curve to the 11-foot curve, it would prove reasonably permanent.

The greatest difficulty the boats navigating this channel found was crossing the bar about the fourth cluster of piles south, as shown by the accompanying map, of an average depth of 6½ feet at mean low water; it was thought best to cut through this shoal.

Mr. S. N. Kimball, the contractor, began work on February 25, 1885, and completed his contract on April 30, 1885.

Mr. John R. Williams was placed in charge of the work as inspector and instructed to commence at a point 100 feet north of the fifth cluster and dredge two cuts of 30 feet each, one 90 feet west of the line of piling, and the other 60 feet west, with a depth of 9 feet, with 1 foot for back filling, and to stop when he had dredged 27,000 cubic yards of material. It resulted in a cut 4,148 feet long, 60 feet wide, and an average of 9½ feet in depth at mean low water, thereby enabling them to cross the bar at low water.

COMMERCIAL STATISTICS.

Amount of business done during the year:

Fish, oysters, sirup, &c	$113,300
Sponges and wood	90,000
Miscellaneous merchandise	340,000
Timber and lumber (34,000,000 feet).	340,000
	883,300

The merchants expect to establish a large cotton trade the coming year, both foreign and coastwise, and should they succeed it will undoubtedly double the amount of business done at present.

Very respectfully, your obedient servant,

A. W. BARBER,
Assistant Engineer.

Capt. WILLIAM T. ROSSELL,
Corps of Engineers, U. S. A.

Commercial statistics of port of Apalachicola, Florida, for the fiscal year ending June 30, 1885.

Arrivals and departures.	Vessels.	Tons.
Coastwise arrivals	30	9,408
Coastwise clearances	35	10,879
American vessels entered (foreign)	6	2,423
American vessels cleared (foreign)	6	2,685
Foreign vessels entered	58	32,825
Foreign vessels cleared	63	35,860
Total	198	94,080

Value of imports	$1,179 37
Value of exports	285,363 00
Revenue collected	2,477 17

Estimated number of vessels arrived at and departed from port not required to enter and clear at the custom-house: Number of vessels, 225; tonnage, 22,500.

To the amount of general commerce of the port you can add 50 per cent. more to the last year's statement.

I am confident that there will be an increase of business at this port for the next year—at least 50 per cent. more.

A. MURRAT,
Special Deputy Collector.

O 5.

IMPROVEMENT OF TAMPA BAY, FLORIDA.

Operations have been carried on since April 27, 1881, under appropriations made by Congress in 1880, 1881, and 1884, aggregating $60,000.

Tampa Bay is a large indentation in the Gulf coast of Florida, and the portion proposed for improvement extends from the wharves of the town of Tampa, near the mouth of the Hillsborough River, to the deep basin in the bay.

Tampa is the terminus of the South Florida Railroad, which there forms connection with the steamship lines for Key West, Havana, and New Orleans. The South Florida Railroad gives by its connections at present a through line to the North, East, and West by the Saint John's River from Sanford, the eastern terminus. Two other railroads are projected to Tampa, the Florida Railway and Navigation Company and the Florida Southern.

An examination of Tampa Bay, with a view to its improvement, was made in 1879. A report thereon, dated August 25, 1879, with a plan of improvement, is printed as Appendix J 18 to the Report of the Chief of Engineers for 1879.

PROJECT OF IMPROVEMENT.

The proposed improvement consists in deepening and widening the channel from Tampa to the bay by dredging and rock excavation so as to give a clear depth of 9 feet at mean low water, with a width in the river of 200 feet and in the bay of 150 feet, a total distance of about $5\frac{3}{4}$ miles.

OPERATIONS UP TO JUNE 30, 1884.

The following appropriations have been made by Congress:

By act approved June 14, 1880	$10,000
By act approved March 3, 1881	10,000
By act passed August 2, 1882	20,000
By act approved July 5, 1884	20,000
Total	60,000

The work has been done by contract, and has resulted in making a cut 60 feet wide and 9 feet deep at mean low water, 8,215 feet long, and a channel of the same depth but 75 feet wide through the rock at the mouth of the river.

There was thus formed a fair, though somewhat narrow, channel, extending through to the wharves at Tampa, 9 feet deep, with the exception of two small shoals below Spanish Town Point and that portion of the channel extending from a point about 300 feet north of Spanish Town Creek to a point about 300 feet below the upper curve, a distance of about 1,000 feet, which has a depth of only 7½ feet.

Before beginning work during the present fiscal year an examination was made which developed the fact that this channel was narrower, and that several other shoals existed along its line.

OPERATIONS DURING FISCAL YEAR ENDING JUNE 30, 1885.

On July 1, 1884, the work was idle for lack of funds, but by act approved July 5, 1884, $20,000 was appropriated.

From the commencement of the fiscal year the work was under the charge of Maj. A. N. Damrell, Corps of Engineers, until he was relieved by me, by virtue of Special Orders No. 96, headquarters Corps of Engineers, United States Army, Washington, D. C., August 5, 1884.

Under the appropriation the work was advertised and bids opened by me on December 10, 1884. As all the bids were considered too high they were, by authority of the Chief of Engineers, dated December 18, 1884, rejected and new bids called for by circular letter. These bids were opened on January 10, 1885.

The lowest bid, that of Mr. James E. Slaughter, being considered reasonable was accepted, and a contract entered into with him, approved by the Chief of Engineers, March 12, 1885.

Under this contract work was begun on May 29, 1885.

Work was begun near the mouth of Hillsborough River, and the soft material taken off the rock by dredging. The rock was then broken by surface blasts and the fragments removed by the dredge.

Up to June 30 a channel has been cut through the ledge 150 feet wide to a depth of 9 feet at mean low water by the removal of 3,632.3 cubic yards of mud and 914.38 cubic yards of rock.

Although this area has been gone over by the contractor an examination has developed three shoals still existing which will be removed under this contract.

It is proposed to spend the balance on hand in making a cut 60 feet wide and 9 feet deep at mean low water through to the deep basin.

The appropriation asked for is to be expended in widening this channel to the proposed width.

Tampa Bay is in the collection district of Key West, which is the nearest port of entry. Nearest light-house, Egmont Key Light. Nearest fort is Fort Jefferson, Florida.

COMMERCIAL STATISTICS.

No custom-house or commercial statistics could be obtained, though application was made to several parties for them.

Money statement.

Amount appropriated by act approved July 5, 1884		$20,000 00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$981 96	
July 1, 1885, outstanding liabilities	6,819 54	
		7,801 50
July 1, 1885, amount available		12,198 50
Amount (estimated) required for completion of existing project		37,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		37,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for improving Tampa Bay, Florida, opened December 10, 1884.

No.	Names of bidders.	Dredging, per cubic yard.	Rock excavation, per cubic yard.	Commence.	Complete.
		Cents.			
1	Rittenhouse Moore	45	$7 85	Not stated	Not stated.
2	S. N. Kimball*	39.3	6 44 3/16	....do	Do.
3	George C. Fobes & Co	40	6 90	....do	Do.

* Lowest bid.

These prices being considered high, it was recommended that the bids be rejected, which recommendation was approved.

Abstract of proposals for improving Tampa Bay, Florida, opened January 10, 1885.

No.	Names of bidders.	Dredging, per cubic yard.	Rock excavation, per cubic yard.	Commence.	Complete.
		Cents.			
1	S. N. Kimball	37	$6 00	Not stated	Not stated.
2	Joe. E. Slaughter*	34.74	5 90	....do	Do.
3	John Maguire	35	5 95	At the time and finish in accord with the specifications.	

* Lowest bid.

Contract awarded to James E. Slaughter. Operations commenced May 29, 1885, to be completed by November 20, 1885.

O 6.

IMPROVEMENT OF THE SUWANEE RIVER, FLORIDA.

Operations for the improvement of this river have been carried on since November, 1881, under appropriations made in 1880, 1881, 1882, and 1884, aggregating $18,000.

The Suwanee River rises in the southern part of Georgia, near the Okefinokee Swamp, and, flowing in a general southerly direction, empties into the Gulf of Mexico a few miles north of Cedar Keys. The portion surveyed with a view to its improvement extends from Ellaville to its mouth. The country adjacent is well wooded, and the chief trade is in pine, cypress, and cedar timber. Cotton, sirup, and the minor farm products are also sent to market at Cedar Keys.

An examination of this river with a view to its improvement was made in 1879. A report thereon, dated August 26, 1879, with a plan of improvement, is printed as Appendix J 16, Report of the Chief of Engineers for 1879.

PROJECT OF IMPROVEMENT.

The proposed improvement consists in deepening the bars at the passes by dredging, the removal of snags and overhanging trees along the river, and the deepening and improving the channel at various places by the removal of rocks, snags, and construction of dams, so as to straighten, widen, and deepen the channel. The depth to be obtained is 5 feet through the bars at the passes for a width of 150 feet, and up the river as far as Boland's Bluff, a distance of 74 miles, and from there up to Ellaville, a distance of 50 miles, 4 feet in depth and 60 feet in width.

OPERATIONS UP TO JUNE 30, 1884.

The following appropriations have been made:

Act approved June 14, 1880	$5,000
Act approved March 3, 1881	3,000
Act passed August 2, 1882	5,000
Act approved July 5, 1884	5,000
Total	18,000

The work has been carried on by contract, and 25,231 cubic yards of material have been removed. All the work done has been in deepening the channel over the bar at the East Pass. This work resulted in securing a channel 2,400 feet long, 65 feet wide, and 6½ feet deep at mean low water.

An examination made previous to beginning work in the present fiscal year showed that the channel had been preserved and the wash or scour had carried the channel to a length of 3,600 feet from where dredging began, with a minimum depth of 6 feet and width of 60 feet. This gratifying result was due in a great measure to the weather, there having been some severe wind-storms in a direction favorable to a scour.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1885.

On July 1, 1884, the work was idle for lack of funds. By act approved July 5, 1884, $5,000 was appropriated for the work. Under this the work was advertised, and bids were opened November 18, 1884.

A contract was made with Mr. S. N. Kimball to carry on the dredging,

approved by the Chief of Engineers, United States Army, January 17, 1885. Under this contract Mr. Kimball was required to begin work on January 10, 1885. This time was extended by authority from the Chief of Engineers, dated February 13, 1885, until June 15, 1885. Operations were begun June 1, 1885. From the beginning of the fiscal year this work was under the charge of Maj. A. N. Damrell, Corps of Engineers, until he was relieved by me by virtue of Special Orders No. 96, Headquarters Corps of Engineers, United States Army, Washington, D. C., August 5, 1884.

Under Mr. Kimball's contract 4,418 cubic yards of material has been removed, forming a channel 829 feet long, 60 feet wide, and 6 feet deep at mean low water.

It is proposed to expend the balance of the appropriation in continuing work under this contract.

As the results expected from this contract will give a channel-way over the bar with a width of 60 feet and a depth of nearly 4.5 feet at mean low water it is proposed to expend the appropriation asked for in extening the improvement up the river by the removal of obstructions.

Suwanee River is in the collection district of Cedar Keys, Fla., and Cedar Keys is the nearest port of entry. Nearest light-house is Cedar Keys Light. Nearest fort is Fort Marion, Fla.

The following paper accompanies this report:

Report of Assistant Engineer A. W. Barber.

Money statement.

Amount appropriated by act approved July 5, 1884		$5,000 00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$507 30	
July 1, 1885, outstanding liabilities	2,176 46	
		2,683 76
July 1, 1885, amount available		2,316 24
Amount (estimated) required for completion of existing project		37,158 00
Amount that can be profitably expended in fiscal year ending July 30, 1887		37,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

Abstract of proposals for improving Suwanee River, Florida, opened November 18, 1884.

No.	Names of bidders.	Dredging, per cubic yard.	Commence work.	Complete work.
		Cents.		
1	Rittenhouse Moore	72½	Not stated.	Not stated.
2	S. N. Kimball *	47	....do....	Less than sixty days after commencement.

* Lowest bid.

Contract awarded to S. N. Kimball dated December 24, 1884; operations commenced June 2, 1885, and are to be completed July 15, 1885.

REPORT OF MR. A. W. BARBER, ASSISTANT ENGINEER.

JACKSONVILLE, FLA., *Jnne* 30, 1885.

CAPTAIN: I have the honor to submit the following report of work done at Suwanee River, Florida, during the fiscal year ending June 30, 1885:

During March, 1885, Mr. J. L. Meigs, assistant engineer, made a survey of the channel across the bar at the mouth of the East Pass and found that the cut made under previous contracts had lengthened 1,140 feet, supposed to have been caused by the two most recent floods in the river.

As directed by you on May 6, 1885, to proceed to Apalachicola and examine the channel, as dredged at that point, and then to go from there to Suwanee and stake out sufficient work, I left Apalachicola on May 12, and arrived at the Suwanee River on May 16. I found that from the crib-stake to a point about 430 feet north of the fisherman's hut on the reef surrounding Suwanee Basin, a distance of about 13,200 feet, the depth of water varies from 3.1 feet to 5.6 feet, except a point 4,170 feet west of the crib-stake, as shown on accompanying map; a small bar with from six to nine-tenths of a foot at mean low water upon it; from the reef it varies from 18 feet to 7 feet. It was thought best to dredge across this bar, so I directed Mr. John R. Williams, the inspector, to commence at a point 4,800 feet west of the crib-stake, and dredge eastward until he had completed a cut 60 feet wide and 5 feet deep, allowing 1 foot for back-filling, and continue until 6,000 cubic yards of material had been removed; then to move up to a point 500 feet west of said crib-stake, and make a cut of the same width and depth, until he had dredged 3,000 cubic yards of material.

The work commenced June 2, 1885, and up to the close of the fiscal year there had been dredged 4,419 cubic yards of material, making a cut 829 feet in length, 60 feet in width, with an average depth of 5.8 feet across the bar at mean low water.

I believe that any future appropriation could be used to better advantage by removing snags and overhanging trees between the mouth of the river and New Bradford, as the channel as dredged will be of sufficient depth to meet the wants of commerce for some years to come.

I have tried to get some commercial statistics, but have not received any up to the present time. The principal export from Suwanee River is pine logs, delivered to the Cedar Keys Saw-Mills. Other products and travel are carried by the steamer Bertha Lee, drawing 2.5 feet feet of water, light, and 4 feet, loaded. She is seldom ever fully loaded, and finds no difficnlty in crossing the bar as it now exists. She makes two trips a week from Cedar Keys up the Suwanee River.

Very respectfully, your obedient servant,

A. W. BARBER,
Assistant Engineer.

Capt. WILLIAM T. RUSSELL,
Corps of Engineers, U. S. A.

O 7.

IMPROVEMENT OF HARBOR AT KEY WEST, FLORIDA.

Operations for the improvement of this harbor have been carried on since July 16, 1883, under appropriarion made by Congress in 1882 of $25,000, the only appropriation made.

Key West is the most northwesterly of the Pine Islands, known as the Florida Keys, 60 miles southwest from Cape Sable, same distance from Tortugas, and 100 miles northeast from Havana. It is about 6 miles long, 2 broad, and from 12 to 15 feet above the sea-level. It is of coral formation and sandy soil.

An examination of the harbor with a view to its improvement was made in December, 1881. A report thereon dated February 16, 1882, with a plan of improvement is printed in Appendix K 25 of the Report of the Chief of Engineers, United States Army, for 1882.

PROJECT OF IMPROVEMENT.

The proposed improvement consisted in forming by dredging a channel 300 feet wide and 17 feet deep at mean low water through the shoals of the northwest channel a distance of about 5,000 feet.

OPERATIONS UP TO JUNE 30, 1884.

The work done was under contract with Mr. S. N. Kimball. Dredging began July 28, 1883, and was continued until October 5, 1883, when the appropriation, $25,000, was exhausted. The work accomplished was the removal of 15,692 cubic yards of material, thereby securing one cut entirely through the bar having a depth of 15 feet at mean low water and a width of 60 feet at bottom and 65 feet at top.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1885.

On July 1 the work was idle for lack of funds, and no appropriation has been made since.

From the commencement of the fiscal year the work was under the charge of Maj. A. N. Damrell, Corps of Engineers, until he was relieved by me by virtue of Special Orders No. 96, headquarters Corps of Engineers United States Army, Washington, D. C., August 5, 1884.

It was stated in the Annual Report for 1884 on this work that—

> Unofficial reports as to the filling up of the dredged channel confirm the opinion expressed in my last annual report, namely, that the improvement would not be permanent.

In two trips made through this channel during the past fiscal year I noted the soundings taken on the mail steamer, and they confirm these reports, namely, that no greaetr depth of water exists now than before work was begun—11 feet at mean low water.

I would therefore ask that an appropriation of $3,500 be made for an examination before more work is attempted.

An improvement here would be of great benefit to all vessels plying between Key West and Gulf ports, the use of this channel saving a distance of about 100 miles to them.

Harbor at Key West is in the collection district of Key West, Fla., which is the nearest port of entry. Nearest light-house, Key West Light. Nearest fort is Fort Taylor, Florida.

COMMERCIAL STATISTICS.

No custom-house or commercial statistics could be obtained, though application was made to several parties for them.

Money statement.

Amount (estimated) required for completion of existing project	$115,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	3,500 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

O 8.

IMPROVEMENT OF PEASE CREEK, FLORIDA.

Operations for the improvement of this stream have been carried on since February 19, 1883, under appropriations made by Congress in 1881 and 1882, aggregating $11,000.

Pease Creek (Talakchopoko, Hatchee, or Peaseating Creek) rises in the northeastern part of township 30 south, range 26 east, and flows northwestward and westward to the middle of section 33, township 29 south, range 25 east, where it makes a junction with Saddle Creek, flow-

ing southeastward from Lake Hancock. Thence its course is southwest to Hickory Bluff, where it empties into Charlotte Harbor, making about 15 miles of westing and 66 miles of southing. It is fed by numerous lakes in the central part of Polk County. The principal tributaries in the east are Little Charley, Tsala-apopka, Josh, and Prairie creeks, and on the west Saddle, Whitten, and Chilocohatchie creeks. Besides these streams wide areas of swamp and hammock lands immediately bordering the river, and of the more elevated adjacent pine lands, are covered during the rainy season, in July and August, with shallow pools of water, which are discharged for the most part into Pease Creek. The stream therefore exhibits much variation in its stages of water, the range between extremes at Fort Meade being about 17 feet.

An examination of Pease Creek, with a view to its improvement, was made late in 1879. A report thereon, dated March 10, 1880, with a plan of improvement, is printed in Appendix K 17, Report of the Chief of Engineers for 1880.

PROJECT OF IMPROVEMENT.

The proposed improvement consisted in rock excavation, removing snags, and clearing the banks of overhanging trees so as to enable boats drawing 2 feet of water to navigate during about half the year; minimum channel width to be 30 feet.

OPERATIONS UP TO JUNE 30, 1884.

The work has been done by a snag-boat built and equipped by the United States, and by hired labor.

Beginning at the mouth of the stream the work has been carried on for a distance of 64 miles.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1885.

On July 1, 1884, the work was idle for lack of funds, and no appropriation has been made since.

From the commencement of the fiscal year the work was under the charge of Maj. A. N. Damrell, Corps of Engineers, until he was relieved by me, by virtue of Special Orders No. 96, headquarters Corps of Engineers United States Army, Washington, D. C., August 5, 1884.

The small balance available for this work has been used in the care of public property.

It is estimated that $5,700 can be profitably expended during the fiscal year ending June 30, 1887.

The work is not y. t sufficiently advanced to estimate whether there will be needed an additional sum to complete the present project.

It is not thought that the improvement will be permanent, and it is estimated that about $2,500 per annum will be necessary to clear the stream of drifts and washouts after each season of high water, in order to maintain the condition contemplated in the proposed project.

From the irregular and desultory character of the transportation, and from the fact that no reliable record is kept of the commerce of the river, which is entirely coastwise, the larger portion being transported overland to Tampa and Manatee, no authentic statement of the same can be given.

It is proposed to expend the appropriation asked in continuing the removal of obstructions according to the project.

Pease Creek is in the collection district of Key West, and Key West is the nearest port of entry. Nearest light-house is on Cinnabel Island, and the nearest fort is Fort Taylor.

COMMERCIAL STATISTICS.

No custom-house or commercial statistics could be obtained, though application was made to several parties for them.

Money statement.

July 1, 1884, amount available	$636 82
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	90 00
July 1, 1885, amount available	546 82
Amount (estimated) required for completion of existing project	5,700 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	5,700 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

O 9.

IMPROVEMENT OF THE HARBOR AT CEDAR KEYS, FLORIDA.

No work has been done under the present project on this harbor.

An improvement was made of this harbor in 1872–1881, as follows: "A cut 200 feet wide and 11½ feet deep, down to the limestone, through the Middle Ground; another, 200 feet wide and 12 feet deep, through the outer bar, excepting at a point 80 feet from the line of black buoys, where the limestone is 11½ feet under the surface; the remaining 120 feet on the east side of the cut being fully 12 feet deep."

The harbor of Cedar Keys lies on the Gulf side of the peninsula of Florida. It is the terminus of the Florida Transit and Peninsula Railroad. For many years this was the only line of railroad between the Gulf and the Atlantic south of Pensacola, in Florida. A large business is done in lumber, and it forms a distributing point to a large area to the north and south of it.

An examination with a view to its improvement was made in November, 1883. A report thereon, together with a plan of improvement, was printed as Appendix N 30 to Report of Chief of Engineers for 1884. The plan of improvement is thus described:

> The first improvement indicated as necessary at this locality is widening and deepening the main channel at the Middle Ground, near Buoy No. 12, and between Buoys Nos. 9 and 12.
>
> The object would be to obtain a channel with a least depth of 10½ feet from the Gulf of Mexico to Cedar Keys. There is now a least depth of 9½ feet.
>
> The depth of 10½ feet for the projected channel is proposed because it is believed to be sufficient for the present commerce of the port, and because to obtain any greater depth would be expensive, as it would require considerable rock excavation, the limestone formation underlying the entire channel at a depth of from 9½ to 12½ feet.
>
> Should, however, an increase of the commerce demand a still greater depth while the proposed improvement was being made, a careful estimate could be made for the additional work required.
>
> The cost of the improvement proposed would be about $25,000.
>
> The amount of material to be removed is only about 22,000 yards, but at least 3,000 yards of this would be rock.

On this project an appropriation of $5,000 was made by act approved July 5, 1884.

OPERATIONS DURING FISCAL YEAR ENDING JUNE 30, 1885.

From the beginning of the fiscal year the work was under the charge of Maj. A. N. Damrell, Corps of Engineers, until he was relieved by me, by virtue of Special Orders No. 96, headquarters Corps of Engineers, United States Army, Washington, D. C., August 5, 1884.

Under the appropriation bids were invited for dredging and rock excavation, to be opened November 18, 1884. Mr. S. N. Kimball was found to be the lowest bidder. His bid being considered reasonable a contract was made with him to do the work; contract approved by the Chief of Engineers January 17, 1885.

Under this contract he was required to begin work February 10, 1885. The time of beginning was extended by authority of the Chief of Engineers, dated February 13, 1885, to August 15, 1885. Consequently no work has been done during the fiscal year.

It is proposed to expend the balance available and the appropriation asked for in extending and widening the cut in accordance with the project.

Cedar Keys Harbor is in the collection district of Cedar Keys, and is a port of entry. Nearest light-house, Cedar Keys Light. Nearest fort is Fort Marion. Amount of revenue collected during fiscal year, none.

Money statement.

Amount appropriated by act approved July 5, 1884	$5,000 00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	197 45
July 1, 1885, amount available	4,802 55
Amount (estimated) required for completion of existing project	20,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	20,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for improving harbor at Cedar Keys, Fla., opened November 18, 1884.

No.	Names of bidders.	Dredging, per cubic yard.	Rock excavations, per cubic yard.	Time to commence work.	Time to complete work.
1	Rittenhouse Moore	$1 45	$9 75	Not stated.	Not stated.
2	S. N. Kimball *	1 00	6 50	...do...	Do.

* Lowest bid.

Contract awarded to S. N. Kimball, dated December 24, 1884, to commence August 15, 1885, and complete September 15, 1885.

COMMERCIAL STATISTICS.

CUSTOM HOUSE, CEDAR KEYS, FLA.,
Collector's Office, June 16, 1885.

SIR: In reply to yours of June 6, 1885, I have the honor to report the following statistics for year ending June 30, 1885:

Vessels.	Entered.				Cleared.			
	Coastwise.		Foreign.		Coastwise.		Foreign.	
	No.	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*	*No.*	*Tons.*
Steamers	12	6,178	4	2,892	13	6,432	.....	.....
Sailing-vessels	6	1,812	1	141	6	368	2	427
Total	.....	7,990	.....	3,033	.....	6,800	.....	427

Value of imports	$20
Value of exports, yellow-pine lumber	1,300

The lumber mills, or all except one, have had to shut down because they had to ship lumber by rail.

Vessels drawing depth of water sufficient to pay cannot get into port.

Very respectfully,

J. HIRST,
Collector.

WM. T. ROSSELL,
Captain of Engineers.

O 10.

IMPROVEMENT OF MANATEE RIVER, FLORIDA.

Operations for the improvement of this river have been carried on under only one appropriation of $12,000, by act passed August 2, 1882.

Manatee River rises in the southern part of Florida and flows in a westerly direction, emptying into Tampa Bay on its southern shore. On its banks exist several small settlements, among which may be mentioned Palma Sola, Manatee, Braiden Town, and Hendry. Along its banks settlers have established themselves, and the raising of fruits and vegetables is quite large. Along its headwaters and in the country lying between it and the Caloosahatchie River and Pease Creek are found fine cattle ranges.

The shipments of lumber, fruits, vegetables, and cattle are carried on from the river.

An examination of Manatee River with a view to its improvement was made in 1881. A report thereon, dated February 16, 1882, with plan of improvement, is printed as part of Appendix K 25, Annual Report of the Chief of Engineers for 1882.

PROJECT OF IMPROVEMENT.

The proposed improvement consisted in forming a channel, by dredging, 100 feet wide and 13 feet deep at mean low water, from Tampa Bay to Shaw's and McNeill's points, a distance of above 4 miles. The available depth before improvement was 8 feet.

OPERATIONS UP TO JUNE 30, 1884.

Dredging was begun on this improvement March 26, 1883, and continued until April 14, 1883. It was again resumed February 18, 1884, and continued until April 25, 1884, when all work ceased, and no further work has been done owing to lack of funds.

During this time one cut was made, 2,150 feet in length, 1,750 feet of which has a width of 60 feet and a depth of 12½ feet, and 400 feet has a width of 35 feet and a depth of 11½ feet; 21,269 cubic yards of material were removed.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1885.

On July 1, 1884, there were no funds available for this work, and no appropriation has been made since.

From the commencement of the fiscal year the work was under the charge of Maj. A. N. Damrell, Corps of Engineers, until he was relieved

by me, by virtue of Special Orders No. 96, headquarters Corps of Engineers, United States Army, Washington, D. C., August 5, 1884.

On July 1, 1884, the work was idle for lack of funds, and has remained so throughout the year for the same reason.

It is proposed to use the appropriation asked for in extending, widening, and deepening the channel by dredging, according to the project.

Manatee River is in the collection district of Key West, which is the nearest port of entry. Nearest light-house, Edomt Keey Light. Nearest fort is Fort Jefferson, Florida.

No commercial statistics could be obtained.

Money statement.

Amount (estimated) required for completion of existing project	$58,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1877	58,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

O 11.

IMPROVEMENT OF CALOOSAHATCHIE RIVER, FLORIDA.

Operations for the improvement of this river have been carried on since October 16, 1883, under appropriations made by Congress in 1882 and 1884, aggregating $10,000.

The portion of the Caloosahatchie which is proposed for improvement extends from its mouth to Fort Meyers, a distance of 14 miles.

The Caloosahatchie River, rising in the Everglades of Florida, flows in a westerly direction and empties into San Carlos Bay but a short distance above Punta Rassa. Through a great portion of its length the land is low, swampy, and unfit for use without expensive drainage. Wherever the land is high, it is rich and capable of producing fruits and vegetables. Along its banks are large cattle ranges. Punta Rassa is the shipping point for this country. This river has been connected by canal with Lake Ockeechobee, by the Ockeechobee Drainage Company, and by this canal a through inland steamboat route has been formed from Kissimee City to the Gulf.

An examination of the river, with a view to its improvement, was made in March and April, 1879. A report thereon, dated August 27, 1879, with a plan of improvement, is printed in Appendix J 17, Report of the Chief of Engineers for 1879.

PROJECT OF IMPROVEMENT.

The proposed improvement consists in deepening the channel by dredging from the mouth of the river to Fort Meyers, so as to give a depth of 7 feet at mean low water and a width of 100 feet.

OPERATIONS UP TO JUNE 30, 1884.

The only work done was dredging from October 16, 1883, to November 6, 1883, under a contract with Mr. S. N. Kimball. It resulted in the removal of 6,905 cubic yards of material. The dredging extended from stake 1 to stake 8 a distance of about 2 miles, and in this distance several small shoals and oyster-beds were removed.

OPERATIONS DURING FISCAL YEAR ENDING JUNE 30, 1885.

On July 1, 1884, the work was idle for lack of funds, but by act approved July 5, 1884, $5,000 was appropriated.

From the beginning of the fiscal year the work was under the charge of Maj. A. N. Damrell, Corps of Engineers, until he was relieved by me by virtue of Special Orders No. 96, headquarters Corps of Engineers, United States Army, Washington, D. C., August 5, 1884.

The work was advertised and bids opened on November 18, 1884. Mr. S. N. Kimball was found to be the lowest bidder. His bid being deemed reasonable, a contract was made with him to continue the work. Contract approved by the Chief of Engineers January 17, 1885. Under this contract the contractor was required to begin work on or before March 10, 1885. The time of commencement was extended by authority of the Chief of Engineers, dated February 13, 1885, to July 15, 1885. Consequently no work has been done during the year.

The citizens living near the river and interested in the navigation petitioned to have the dredging done below Punta Rassa, in San Carlos Bay, but this had to be denied by the Chief of Engineers as not being permissible under the law, the appropriation having been made by Congress to carry out a project which did not extend beyond the mouth of the river.

It is proposed to use the balance available and the appropriation asked in extending the cut by dredging towards Fort Meyers in accordance with project.

The following appropriations have been made:

By act of Congress passed August 2, 1882	$5,000
By act of Congress approved July 5, 1884	5,000
Total	10,000

Caloosahatchie River is in the collection district of Key West, which is the nearest port of entry. Nearest light-house is Key West Light, and the nearest fort is Fort Taylor.

Money statement.

Amount appropriated by act approved July 5, 1884	$5,000	00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	544	71
July 1, 1885, amount available	4,455	29
Amount (estimated) required for completion of existing project	13,400	00
Amount that can be profitably expended in fiscal year ending June 30, 1887	13,000	00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

Abstract of proposals for improving Caloosahatchie River, Florida, opened November 18, 1884.

No.	Names of bidders.	Dredging per cubic yard.	Commence work.	Complete work.
		Cents.		
1	Rittenhouse Moore	90	Not stated	Not stated.
2	S. N. Kimball	*69.9	do	Do.

* Lowest bid.

Contract awarded to S. N. Kimball, dated December 24, 1884, to commence July 15, 1885, and completed August 15, 1885.

O 12.

IMPROVEMENT OF APALACHICOLA RIVER, FLORIDA.

Operations for the improvement of this river have been carried on since December, 1874, under appropriations made by Congress in 1874, 1875, 1878, 1879, 1880, 1881, 1882, and 1884, aggregating $39,500.

The following description of the river is taken from a report made by Assistant Engineer M. J. Mack to Captain (now Major) A. N. Damrell, Corps of Engineers, on June 7, 1883:

> The Apalachicola River is formed by the junction of the Chattahoochee and Flint rivers, at the southwestern corner of the State of Georgia, and runs in a southerly direction through the State of Florida, emptying into Saint George's Sound at the city of Apalachicola, passing through a very low, swampy country, which is annually overflowed by the freshets from the Chattahooche and Flint rivers, rendering the land comparatively useless for agricultural purposes for a great distance on either side. There is, however, a quantity of fine timber, mostly cypress and pine, along its banks, and as it has a number of tributaries extending far into the country, among them Chipola River, Canada, Owl, Fort Gadson, Smith, and Brinsley creeks, a fine means is given of rafting it to Apalachicola, where two (now four) mills of large capacity are kept in constant operation.

The importance of this river has increased since then by a steady growth of the settlement along its banks, especially of the town of Apalachicola at its mouth.

Cotton is grown along the banks and turpentine and resin shipped.

PROJECT OF IMPROVEMENT.

The project consists in securing a channel 100 feet wide and 6 feet deep at low water by removing snags and overhanging trees, as well as widening and straightening Moccasin Slough.

OPERATIONS UP TO JUNE 30, 1884.

This improvement was commenced in December, 1874, the steamboat Clara Dunning being employed in removing logs and overhanging trees.

The depth of water was sufficient, as well as the general width from bank to bank, but its availability for purposes of commerce was bad, in consequence of numerous snags.

The river at Virginia Bend, 50 miles above Apalachicola, was completely closed for a distance of 6 miles, and the only chance for navigation was through Moccasin Slough, which was very crooked, narrow, and badly obstructed with overhanging timber, so much so that it required several days for a boat with the use of lines to pull through.

The original project for improvement contemplated a channel 100 feet wide and 6 feet deep at low water, to be secured by removing snags and overhanging trees, as well as widening and straightening Moccasin Slough, and no change has been made in the original design.

In addition to the original project, Chipola Cut-off has been opened to White's Bluff, on Chipola River, a distance of 9 miles.

The improvement may be considered as completed as projected, the river being in good navigable condition, and only requiring the removal of the annual accumulation of snags and overhanging trees and such work as can be done with the amount of $2,000, which has been estimated as necessary annually for preserving the improvement.

OPERATIONS DURING FISCAL YEAR ENDING JUNE 30, 1885.

From the beginning of the fiscal year the work was under the charge of Maj. A. N. Damrell, Corps of Engineers, until he was relieved by me by virtue of Special Orders No. 96, headquarters Corps of Engineers, Washington, D. C., August 5, 1884.

On July 1, 1884, the balance available was $1,310.69, and by act approved July 5, 1884, $1,000 was appropriated.

The snag-boat Clara Dunning had finished cleaning the river only a short time before the beginning of the fiscal year. In view of this no steps were taken to begin work early in the year. In June, 1885, some complaints having been made of a few snags in the river, it was thought advisable to undertake the work. The steamer Clara Dunning, having been worn out in the service, had been sold. After corresponding with owners of steamboats on the river, it was found that no reasonable offers could be obtained.

Authority was then asked to charter a small steamer, and tow the United States snag-boat, belonging to the improvement of Pease Creek, to Apalachicola River to do the work of removing the accumulation of snags for the past year. Authority was granted by the Chief of Engineers on June 30, 1885.

It is expected that the snag-boat will start about the middle of July.

The balance available and the appropriation asked are to be used in preserving the improvement by the removal of obstructions according to project.

The following appropriations have been made:

By act of Congress approved June 23, 1874	$10,000
By act of Congress approved March 3, 1875	10,000
By act of Congress approved June 18, 1878	8,000
By act of Congress approved March 3, 1879	5,000
By act of Congress approved June 14, 1880	2,000
By act of Congress approved March 3, 1881	1,500
By act of Congress passed August 2, 1882	2,000
By act of Congress approved July 5, 1884	1,000
Total	39,500

Apalachicola River is in the collection district of Apalachicola, which is the nearest port of entry. Nearest light-house, Cape St. George Light. Nearest fort, Defenses of Pensacola, Florida. Amount of revenue collected during fiscal year, $2,477.17.

Money statement.

July 1, 1884, amount available		$1,310 69
Amount appropriated by act approved July 5, 1884		1,000 00
		2,310 69
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884		55 20
July 1, 1885, amount available		2,255 49
Amount (estimated) required for preservation of improvement annually.	2,000 00	
Amount that can be profitably expended in fiscal year ending June 30, 1887	2,000 00	
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

O 13.

IMPROVEMENT OF WITHLACOOCHEE RIVER, FLORIDA.

Operations for the improvement of this river were carried on during the past fiscal year in accordance with the project submitted to the Chief of Engineers by the officer then in charge in 1879, and published as part of Appendix K 8 to the Annual Report of the Chief of Engineers for 1880.

The project adopted is to improve the river by the removal of snags, overhanging trees, and loose rocks, and a deepening of some of the worst shoals and a bar near the mouth of the river, so as to enable boats drawing 2 feet to navigate the river during about half of the year.

The original depth of the river was from 1 to 7½ feet, with a width of from 75 to 150 feet.

OPERATIONS PRIOR TO JUNE 30, 1884.

Under previous appropriations a suitable snag-boat had been built and equipped, and the river had been gone over for a distance of 100 miles from its mouth.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1885.

On July 1, 1884, there were no funds available for the work, but there was an appropriation by act of July 5, 1884, of $3,000. From the beginning of the fiscal year the work was under the charge of Maj. A. N. Damrell, Corps of Engineers, until he was relieved by me by virtue of Special Orders No. 96, headquarters Corps of Engineers, United States Army, Washington, D. C., August 5, 1884.

On September 8, 1884, a force was organized at Cedar Keys, Fla., and sent to Pease Creek, where the snag-boat was at that time laid up in charge of a watchman.

On arrival there the boat was drifted down-stream and beached near the settlement of Charlotte Harbor, Fla. The repairs required were found to be so great that it was decided to remove her to Cedar Keys for this purpose. Leaks were temporarily repaired, and after much delay in procuring a tow-boat without paying an exorbitant price, the boat started for Cedar Keys, Fla., arriving there on October 31. Here she was put in good order, and started for the Withlacoochee River on November 20, arriving at the scene of operations on December 6. Work was begun 2 miles below Camp Izard. From this time until work ceased, on January 31, 1885, the following work was done, viz:

Cubic yards rocks removed	496¼
Logs removed	35
Cubic yards riprap dam built	23

Much more work would have been done under this appropriation but for the distance the snag-boat had to be moved, both for repairs and to the points to be improved.

EFFECT OF THE WORK.

There now exists a navigable channel from the mouth of the river up to Morrison's Landing. The width in many places, however, should be increased.

It is proposed to extend the improvement up to Fort Dade. The upper river has been reached by two railroads, the Florida Southern and the Florida Transit and Peninsular.

This increases the importance of the improvement of the upper river. The principal industry of the country is the raising and shipping of fruits and vegetables. The arrival of the railroads has given a great impetus to this business and they seek the river as a means of transportation to the roads.

The money now available is to be used for the care and preservation of the public property.

The appropriation asked for is to be applied to extending the improvement under the existing project.

The following appropriations have been made:

By act of Congress approved March 3, 1881	$7,500
By act of Congress approved July 5, 1884	3,000
Total	10,500

Withlacoochee River is in the collection district of Cedar Keys, Fla., which is the nearest port of entry. Nearest light-house, Cedar Keys Light. Nearest fort is Fort Marion, Florida.

Money statement.

Amount appropriated by act approved July 5, 1884		$3,000 00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$2,541 20	
July 1, 1885, outstanding liabilities	30 00	
		2,571 20
July 1, 1885, amount available		428 80
Amount (estimated) required for completion of existing project		13,400 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		13,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

COMMERCIAL STATISTICS.

FLORIDA SOUTHERN RAILWAY COMPANY,
FLORIDA COMMERCIAL COMPANY,
Palatka, Fla., June 3, 1885.

SIR: In answer to your request of May 2, to furnish you a statement of the present and prospective commerce of the Withlacoochee River, I would respectfully state as follows: After leaving the mouth of said river the land adjacent to river is low, and of a very poor quality of pine land for 10 or 15 miles. The first settlement of any importance is that known as Renfrew or Renfro settlement, about 25 miles from the mouth. The lands in this neighborhood consist of first-class pine and hummock lands. Want of transportation has so far prevented emigration to this portion of the State, but those who are already there are progressing and depend but little upon the outside world for sustenance. Near this point the first obstruction is met to navigation in the form of rocky shoals extending across the river which at low water is impassable.

There are about thirty or forty families living in a radius of 5 or 6 miles, all engaged in farming and the cultivation of orange groves not yet bearing. Vegetables will be made a specialty in that region should the river be made navigable at low water. The next object of interest is what is known as Blue Spring Run, which empties itself in the river, its source being the celebrated Blue Springs, equal in depth, beauty, and magnitude to the Silver Springs near Ocala. There is quite a large settlement in the vicinity of the springs, a large hotel in progress of erection, store, sawmill, &c. The distance from river is about 6 miles. The next settlement is Camp Izard, on the bank of the river, consisting of two stores, dwellings, &c. This neighborhood is quite thickly settled, and shipped this year several thousand boxes of oranges from the groves now in bearing, which form a very small percentage of those in cultivation and which will be in bearing in a couple of years. From this point to Panasoffkee Run the United States snag-boat has removed the rocky shoals from the river, and the navigation is comparatively good to that point. Six or seven miles from Camp Izard is Stokes Ferry quite a large settlement of thirty or forty families within a radius of 3 miles. Three or four thousand boxes of oranges were shipped from this neighborhood during the past year, the producer being compelled to haul in wagons to Ocala, a distance of 25 miles.

The lands in this vicinity are high and rolling pine, and are of superior richness in soil. These lands are peculiarly adapted to the culture of vegetables, and those who have tried it say that if proper transportation by water or rail is ever furnished them that vegetable farms will take the place of orange groves.

Stokes Ferry will be the shipping point for the Apopka lakes, which are 5 or 6 miles from the river. From this point, should navigation be opened this year, 6,000 or 7,000 boxes of oranges will be shipped.

From Stokes Ferry to Cotton's Landing, a distance of 20 miles, the lands adjacent to the river are low and swampy. In the vicinity of Cotton's Landing there are a number of settlers, and this place will be quite a prominent shipping point. About 1,000 boxes will be shipped from this point during the current year if water transportation is furnished. With only a few miles intervening, we pass on our way up the river, as far as Panasoffkee Run, numerous vegetable farms and orange groves, the owners using barges to transport the products of their lands to Panasoffkee, the nearest shipping point on the railroad.

On Panasoffkee Run, about 1½ miles in length, which connects the lake with the river, there are 500 acres in orange groves, one-half of which are bearing. From this point to the mouth of the river, if the same is made navigable, should estimate the number of boxes of oranges that will be shipped by steamer during the current year between 25,000 and 30,000 boxes. As vegetables will be raised by every settler, it is almost impossible to estimate the amount.

Want of quick trransportation is the present obstacle to that industry.

Cove Bend Landing is the next point of importance on the river. Here is at present the largest shipping point on the river, it being only 2½ miles from Floral City and surrounded by some of the finest groves in the State. Eight or ten thousand boxes can be shipped from here annually. It is one of the finest vegetable regions in the State. Istachatta, about 12 or 15 miles farther up the river, is the next most important shipping point. The lands in this vicinity, being first-class pine and hummock, are being rapidly improved. Six or seven miles further Pemberton's Ferry is reached, which is as far as it is possible to make the river navigable.

At present there is but one steamboat on the river, and it has been able to do but little on the river, owing to extreme low water and obstructions, which at present prevent her reaching either Panasoffkee, on F. R. and N. Railroad, or Pemberton's Ferry, the present terminus of The Florida Southern Railway. There is but little work needed to form a water connection between the two railroads. The present steamer on the river is 20 tons and draws about 2 feet.

I will close by stating that the country adjacent to the Withlacoochee River is yet undeveloped, but an infinitesimal quantity of the land under cultivation, and less facility of transportation given than any other river of its length in Florida; still to-day it stands second to but one other river in the State, viz, the Saint John's, in the amount of freight ready to be shipped when the river can be navigated by steamers. By reference to the maps it will be seen that this river runs through three of the richest counties in the State, Marion, Sumter, and Hernando, and through some of the richest portions of those counties. Water transportation will surely cause a tide of emigration to flow in that direction and it is sincerely to be hoped that Congress will take steps to furnish the means so much needed to make the river navigable. It is impossible to be accurate as regards the present resources of the comparatively unknown region or how great they may become if the inducement of good transportation is offered in the future.

Yours, respectfully, &c.,

SHERMAN CONANT,
General Manager.

Capt. WILLIAM T. ROSSELL,
United States Corps of Engineers.

O 14.

REMOVING SUNKEN VESSELS OR CRAFT OBSTRUCTING OR ENDANGERING NAVIGATION.

The wreck of the steamer Dictator was reported to the Secretary of War as being an obstruction to the navigation of the harbor at Tampa, Fla.

I was directed by the Chief of Engineers to take the preliminary steps toward removal of same.

Notice was published to all parties interested in the wreck and cargo of the steamer to remove it or it would be declared abandoned and the United States would remove it.

This was replied to by Messrs. Miller and Henderson, the owners, that they would entirely remove the wreck and cargo.

They are now engaged in its removal, and no further action is necessary on the part of the United States at present.

O 15.

PRELIMINARY EXAMINATION OF ANCLOTE HARBOR, FLORIDA.

Anclote Harbor is situated on the west coast of the peninsula of Florida, about 15 miles above Tampa Bay.

The harbor, protected by the mainland and North and South Anclote Keys, affords a safe anchorage for coasters drawing not more than 11 feet of water. A pier-head is built here, at which steamers plying between Cedar Keys and Tampa stop and land passengers and freight. As a harbor of refuge for the coasters the anchorage is ample both in area and depth of water. From this pier-head a shallow, narrow, and crooked channel leads to the village of Anclote, near the mouth of Anclote River.

There are at present two small vessels running between Anclote River and Cedar Keys. The channel is available for steamers and vessels drawing not more than 3 feet. A steamer adapted to the water is to be put on, I understand, next month.

I inclose a letter concerning this harbor from the collector of customs at Cedar Keys, and also certain data collected by Mr. A. W. Barber, assistant engineer.

I do not think that the harbor is at present worthy of any improvement.

Respectfully submitted.

WM. T. ROSSELL,
Captain of Engineers.

UNITED STATES ENGINEER OFFICE,
Jacksonville, Fla., November 3, 1884.

REPORT OF MR. A. W. BARBER, ASSISTANT ENGINEER.

CEDAR KEYS, FLA., *October* 20, 1884.

CAPTAIN: I have the honor to submit the following report of the inquiries made at Cedar Keys in regard to the harbor at Anclote, Fla.

I am informed by captains and pilots who are familiar with Anclote Harbor that at its mouth there is a pier running out to water at a depth of 8 feet, upon which all steamers with a draught of over 3 feet land their cargo for Anclote and Tarpon Springs; from the pier to the above places it is moved on lighters. From this pier to Anclote Dock, a distance of 2½ miles, the channel is very crooked and narrow, varying in width from 30 to 50 feet, with an average depth at mean low water of 3 feet. Capt. C. Y. McCormick, who runs the steamer Eagle Pencil, says "that his boat, with a draught of 3 feet, has no trouble to get up to Anclote Dock, except at a point one-quarter of a mile below Anclote Dock, where the limestone rock crops out, covering the whole channel for a length of 30 feet." Captain Millard says "it is over 100 feet long."

From Anclote Dock to Tarpon Springs, a distance of 2 miles, there are two oyster-beds that obstruct the channel the whole width for a length of 750 feet each, with an

average depth at mean low water of 1½ feet. The rise and fall of the tide at this point is about 2½ feet.

COMMERCIAL STATISTICS.

The principal business at Anclote Harbor is the gathering and curing of sponges and fishing. Anclote has one store and a few houses. Tarpon Springs is situated upon Lake Butler. They have one hotel that is opened for winter guests only. The Lake Butler Villa Company has for sale over 70,000 acres of land, and are trying to build up this settlement. They expect to run the steamboat Governor Safford (now being built at Wilmington, Del., for that purpose) from Cedar Keys to Tarpon Springs.

From what I can learn, the amount of business done at both places would not warrant any improvement of the harbor at present.

I am, very respectfully,

A. W. BARBER,
Assistant Engineer.

Capt. WILLIAM T. ROSSELL,
Corps of Engineers, U. S. A.

LETTER OF THE COLLECTOR OF CUSTOMS AT CEDAR KEYS, FLORIDA.

CUSTOM-HOUSE, CEDAR KEYS, FLA.,
Collector's Office, September 18, 1884.

SIR: In reply to yours of September 11, I would say that, from what knowledge I have of Anclote Harbor, I am of the opinion that it will not pay to expend much money on it. The river is too sluggish to keep the channel clear if it was made deeper. The place is not of sufficient importance to warrant the spending of much money, and a small amount would not give any permanent benefit.

Respectfully,

J. HISSE,
Collector.

WM. T. ROSSELL,
Captain of Engineers.

O 16.

PRELIMINARY EXAMINATION OF WEKIVA RIVER, FLORIDA.

The Wekiva River is a tributary of the Saint John's River, Florida, and is about 16 miles in length.

It flows through a well wooded country, its banks being generally swampy. It empties into the Saint John's River, about 5½ miles below Lake Monroe. On the Saint John's River from this point to Jacksonville there are several steamboat lines and ample facilities for freight. Before the building of the South Florida Railroad a steamer ran on this river, and last year one was put on the route but has been withdrawn. At present two barges are poled up and down the river and attend to all the freight business.

Near the head of navigation of this river is a country fast settling up, and the improvements made will soon require some outlet, but I am of the opinion that for some time there will be no need of any improvement. I made several attempts to get commercial and business statistics concerning this river without success, but from conversations with planters in that section I am of the opinion that were a steamer put on this river there would be from 20,000 to 30,000 boxes of oranges for her to move, and that this will increase rapidly with time.

I append herewith a copy of a letter from Mr. H. C. Miller, of Longwood, Fla., an engineer, who made a survey of the river a year or two ago.

A personal examination shows the same facts in reference to the depth of water and width of stream as given in letter of Mr. Miller.

Respectfully submitted.

WM. T. ROSSELL,
Captain of Engineers.

UNITED STATES ENGINEER OFFICE,
Jacksonville, Fla., November 3, 1884.

LETTER OF MR. H. C. MILLER.

LONGWOOD, FLA., *October* 18, 1884.

DEAR SIR: Your letter of the 17th instant to hand, asking information concerning the Wekiva River, and in reply will state that the survey showed the first 2 miles up from its confluence with the Saint John's to be quite crooked, with a depth of water from 10 to 16 feet.

The next 2 miles, also quite crooked, with a depth of water from 5 to 10 feet, all through a low swamp easy to cut; average width of stream 60 feet.

The next 4 miles the stream is from 50 to 250 yards wide, with an occasional island, with a depth of water from 1½ to 4 feet, but it has a channel about 1 mile in length, averaging 5 feet deep, showing cut would soon wash and cut deep.

The next 4 miles to the fork of the Wekiva, or east branch, and the Clay Springs, or west branch, is from 25 to 75 yards wide, with several islands, one or two sharp turns, with a depth of water from 4 to 6 feet.

The last 2¼ miles from the fork up the Clay Spring branch will average 50 feet wide, with two sharp turns and a depth of water from 6 to 10 feet.

The Wekiva branch has the same depth of water and width of stream, all but the last mile from Hoosier Springs, which mile is quite narrow and shallow in places; it also has more sharp turns and snags than the other branch.

The depths given were taken at mean low water, though it does rise several feet near its source with the Saint John's.

The velocity of the water was not taken, though I should guess it runs about 3 miles per hour in the branches.

The length of the stream I give you, 15½ miles, was measured down the center of the stream, including all its crooks and turns.

The opening up of this stream for navigation would be of immense benefit to all the country for almost its entire length and for several miles out, for the settlers there cannot receive or ship their produce except by long hauls in teams; it would also be the means of improving the hummock lands along its banks, and bring its immense and valuable timber growth within reach of saw-mills, and I am also assured that were there some way of shipment there would be many shingle mills built along the stream.

I have given you such information as I thought you required concerning the stream from Clay and Hoosier Springs to its source. Should you want any more minute information, or concerning its tributaries, such as the Black Water, Rock Spring, or Upper Wekiva branch, I will gladly furnish such information as I have at hand.

Hoping the above will prove satisfactory, I am, and remain, yours, &c.,

H. C. MILLER.

WM. T. ROSSELL,
Captain of Engineers, U. S. A.

O 17.

PRELIMINARY EXAMINATION OF SAINT AUGUSTINE HARBOR, FLORIDA.

The harbor of Saint Augustine lies on the east coast of Florida, about 35 miles south of the mouth of the Saint John's River.

But little commerce is carried on from this port, and the depth of water at present available, 11 feet at mean high water, is considered ample for the requirements of commerce.

I would respectfully invite particular attention to the report of Mr. A. W. Barber, assistant engineer, a copy of which is appended, and also to copy of a letter* from the deputy collector of customs at Saint Augustine.

I made a set of soundings through the channel at low water and found 8½ feet of water, which would indicate that the water available at high water was from 12 to 12½ feet.

Respectfully submitted.

WM. T. ROSSELL,
Captain of Engineers.

UNITED STATES ENGINEER OFFICE,
Jacksonville, November 3, 1884.

REPORT OF MR. A. W. BARBER. ASSISTANT ENGINEER.

SAINT AUGUSTINE, FLA., *October* 29, 1884.

CAPTAIN: In accordance with your order of the 25th instant, I respectfully submit the following report of my examination of the harbor at Saint Augustine, Fla.

Saint Augustine is situated on a peninsula between the Matanzas River and the Saint Sebastian River, with the Anastatia Island and North River between it and the ocean. Commencing at Saint Augustine, we follow the Matanzas River in a northerly direction for 1¼ miles, with a depth of from 15 to 27 feet at mean low water, until it intersects the North River near Marsh Island; at this point the channel narrows down to about 300 feet, with a depth of 25 to 30 feet. It then flows around the north side of Marsh Island into the North River; thence in a southeasterly course for about 2 miles in the direction of the old light-house. The water ranges from 18 to 30 feet in depth, except just opposite the new light-house, where a shoal of coquina rock runs out from Anastatia Island, with the depth of 11 feet at low water, but the channel is about 400 or 500 feet wide at this point, with from 18 to 21 feet of water, so that the shoal does not interfere with the ship-channel. At this point there are two channels, one going in a northeasterly direction around the southern point of the north beach, a distance of about 1¾ miles, with a depth of from 20 to 11 feet, except over the bar, which the pilots give as 7 feet; but I find the Coast Survey gives 9 feet. The other channel, the main ship-channel, follows the east side of Anastatia Island for a distance of 1 mile, with a depth of 18 to 20 feet; and thence in a northeasterly direction for about 1 mile to the inner bar, with a depth of about 18 feet. At this point there are three bars, one-quarter mile apart, and from 200 to 250 feet long, with a depth of 8 feet at low water. They are sand, and of a shifting character. At the points over the bars I had to take the pilot's soundings, as the sea was running too heavy for our boat to cross them.

Returning to Saint Augustine docks, we follow the Matanzas River 1¼ miles in a southerly direction to the mouth of the Saint Sebastian River, with a depth of from 24 to 30 feet. From this point the Saint Sebastian River is navigable for 2½ miles, with an average depth of over 12 feet at low water, except at two points, at the mouth of the river and 1 mile above it. The bar at the mouth is about 800 feet long, with an average depth of 7½ feet at low water. The other bar is about 1,500 feet long, with an average depth of 7 feet at low water. The rise and fall of the tide at this point is about 5 feet, so that at high water a vessel drawing 11 feet can pass over any of the bars.

COMMERCIAL STATISTICS.

Saint Augustine has a resident population of about 4,000, and I am informed by Mr. Lyons, one of the leading business men, that the total amount of business done is about $1,000,000 per year.

They have at present two saw-mills, turning out about 16,000 feet of lumber per day, and another now under construction by an English company. Dr. Slowgett, the general manager of the company, says that its capacity will be 30,000 feet of lumber per day, and adds that he anticipates that the home trade will use that up, leaving very little timber to export. I understand through the agents of the Warren

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* Omitted; printed in House Ex. Doc. No. 71, Forty-eigthh Congress, second session.

Ray and S. Gildersleive ship lines that they received the last year the following vessels:

Line, &c.	Vessels.	Tons.
Warren Ray Line	20	4,000
S. Gildersleive Line	12	2,400
The Ice Company	6	1,200

I learn through the collector of customs that there have entered and cleared that port for the year ending June 30, 1884, the following vessels:

Directions.	Entered.		Cleared.	
	Vessels.	Tons.	Vessels.	Tons.
Coastwise	28	6,147.61	9	2,009.34
Foreign	2	397.15	2	262.47
Total	30	6,544.76	11	2,271.81

Excess of tonnage entered over that cleared, 4,272.95.

This confirms the report that they have to send about two-thirds of the vessels entering that port to Jacksonville or Fernandina for ballast. The Alantic Coast Steamship Company at present runs the steamer Greenwich from New Smyrna to Saint Augustine, making three round trips per week. Dr. Westcott, the president of the steamship line, claims that as soon as the canal is opened to Biscayne Bay a large part of the fruit trade of the West Indies will go through this harbor. They have two railroads terminating here that transport a large part of the trade.

In summing up, I find that any vessel with a draught of 11 feet can pass the bars at high water, and with the amount of business done at this port, I do not deem it of enough commercial importance to recommend a survey of the harbor.

I am, very respectfully, your obedient servant,

A. W. BARBER,
Assistant Engineer.

Capt. W. T. ROSSELL,
Captain of Engineers, U. S. A.

O 18.

PRELIMINARY EXAMINATION OF AMELIA RIVER, FLORIDA.

The course of this river lies for its whole length in the swamps between the mainland and the islands, on the coast of Florida. Along its headwaters are a few settlers, and by them small boats and lighters are used. Rafts are also brought down by this river to the mills at Fernandina.

The most important feature of the river is that it forms a part of the inland route from Cumberland Sound, Georgia and Florida, to the Saint John's River.

An examination of this route, with a view to its improvement, was made under the direction of Col. Q. A. Gillmore, Corps of Engineers, U. S. A., the report on which was published as Appendix U, page 48, Part II, Report of Chief of Engineers, U. S. A., for 1875. In this report Colonel Gillmore divides the route into two sections. The upper section comprises the route from Nassau Sound to Cumberland Sound, and passes through the South Amelia River, Kingsley's Creek or Cut, and Amelia River.

Of this section it is stated that Kingsley's Cut and about 1½ miles of South Amelia River, immediately south of it, are the only places where any obstacles exist to the passage, at high water, of vessels drawing 13 feet; in fact for the remainder of the route they can pass at low water. The improvements to be made here consist of making a cut to avoid a sharp bend, and deepening the existing channel. For this whole improvement Colonel Gillmore recommends the adoption of—

A channel 80 feet wide by 11 feet deep, at high water, at an estimated cost of $160,000.

It is also stated in this report that—

It appears that appropriations for its improvement were made at various times from 1828 to 1838, amounting in the aggregate to the sum of $78,000, the bulk of which was expended in dredging out Kingsley's Cut, Amelia River, 3 or 4 miles south of Fernandina, and Gunnison's Cut, in Sawpit Creek, 4½ miles south of Nassau Sound.

A report made by Capt. J. C. Post, Corps of Engineers, U. S. A., to Col. Q. A. Gillmore, June 22, 1877, touches on this subject. It is printed in Appendix H to Report of the Chief of Engineers, U. S. A., for 1877, Part I, page 378. The following is an extract from this report:

Proceeding from Fernandina toward the south, through the Amelia River, the width and depth of the channel is ample for the navigation of vessels of moderate draught as far as the second reach before entering Kingsley's Cut. Through this latter, for a distance of 100 yards, there is but 4 feet at low water. The width, however, is sufficient. Passing on to Kingsley's Cut and through it, between the piers of the Florida Railroad draw-bridge, which are only about 50 feet apart, there is sufficient water until the southern end of the cut is reached. Here, for a distance of 100 yards, the channel is but 50 feet wide and 4 feet deep at low water. Beyond this cut, in passing through the dividing basin of the Amelia River, for a distance of 200 feet, the channel at low water, though sufficient in depth, is but 35 feet wide. Again, just to the south of this narrow portion, for a distance of 150 feet, the channel, which is sufficiently wide, is but 4 feet deep at low water.

A personal examination of Amelia River and Kingsley's Creek was made by me on October 8, 1884. The only local traffic is carried on by small boats and lighters, and for these the width and depth is ample.

In view of the report made by Colonel Gillmore of the inside route from Fernandina to the Saint John's River, I do not think it is necessary to make any additional survey until funds be available to carry on the projected improvement in the lower section of the route.

I append herewith copy of a letter from Mr. J. W. Howell, collector of customs, Fernandia, Fla., referring to the commercial importance of this stream.

Respectfully submitted.

WM. T. ROSSELL,
Captain of Engineers.

UNITED STATES ENGINEER OFFICE,
Jacksonville, Fla., November 3, 1884.

LETTER OF THE COLLECTOR OF CUSTOMS AT FERNANDINA, FLORIDA.

CUSTOM-HOUSE, FERNANDINA, FLA.,
Collector's Office, September 20, 1884.

SIR: Replying to your letter of the 15th instant, I would say that the navigation of the inside passage from here to Saint John's River, which includes the Amelia River, has been confined almost, if not quite, exclusively to vessels of light draught, not sea-

going, between ports of this State and Georgia. As such vessels go and come without entering or clearing, no official record or statistics are kept.

I can only say further that I think your view is correct, viz, that the importance of the river consists almost wholly in its forming a part of the inside passage.

The few families who live along its bank use only small boats and lighters.

Whatever can be done to better the navigation of the inside route will, in my opinion, be accomplishing the "greatest good to the greatest number of people."

I am, very respectfully,

J. W. HOWELL,
Collector.

WM. T. ROSSELL,
Captain of Engineers, U. S. A.

O 19.

PRELIMINARY EXAMINATION OF CHARLOTTE HARBOR, FLORIDA.

An examination of Charlotte Harbor was made under the direction of Capt. (now Major) A. N. Damrell, Corps of Engineers, U. S. A., in the fall of 1879, by Mr. J. L. Meigs, assistant engineer, and published as Appendix K 17 to Report of the Chief of Engineers, U. S. A., for 1880, Part II, page 1100.

Major Damrell says of this harbor:

> The principal commerce carried on in the harbor consists in the export of cattle to Cuba and oranges to Cedar Keys. Vessels drawing 8 feet of water can load at Knight's Pier on the north shore, about 1½ miles below Hickory Bluff, and go to sea without difficulty through Boco Grande Pass, while vessels of lighter draught have four other outlets which they make use of according te prevailing winds and draught of vessels.

In this connection I would also quote from a petition from all the vessel-owners and captains using the Caloosahatchie River. In this petition it is asked that the appropriation of $5,000 by act of August 2, 1882, for improvement of Caloosahatchie River be expended on bar between Punta Rassa and the Gulf. In this petition it is stated that no use can be made of the improvement on the river unless the channel over the bar is deepened. This bar lies in San Carlos Bay, Charlotte Harbor, and is opposite and just below Punta Rassa. The bar is not over 600 to 700 feet long, and at low water no vessel can pass over it drawing over 5 feet.

The improvement desired is to deepen the channel to 9 feet at low water, which will make Punta Rassa a good, safe harbor for vessels drawing 7 to 8 feet of water.

In report of Mr. J. S. Walker, assistant engineer, to Maj. A. N. Damrell, it is stated that this bar consists of sand.

I have endeavored to get data from the citizens concerning the amount of business done here, but without success. From conversations with persons from that section I am informed that but little business is done.

I am of the opinion that nothing further need be done at present with a view to the improvement of this harbor.

Respectfully submitted.

WM. T. ROSSELL,
Captain of Engineers.

UNITED STATES ENGINEER OFFICE,
Jacksonville, Fla., November 3, 1884.

O 20.

PRELIMINARY EXAMINATION OF MOSQUITO INLET, FLORIDA.

Mosquito Inlet is situated on the east coast of Florida, about 86 miles south of the mouth of the Saint John's River. It is at the junction of the Halifax River and Hillsborough River, and connects them with the ocean. By means of the Haulover Canal the Indian River and Mosquito Lagoon are connected, and thus the whole line of interior communication is connected with the Mosquito Inlet down to Jupiter Inlet.

This section, healthy and unsurpassed for the culture of tropical fruit, will soon be settled, and the amount of freight to be carried in and out will be enormous. At present there is one steamer, the Greenwich, making semi-weekly trips to and from Saint Augustine, and two schooners plying to and from Jacksonville.

The amount of freight and passengers carried is given here from an estimate made by the agent of the steamer Greenwich:

Passengers carried to Mosquito Inlet October 1, 1883, to June 30, 1884	320
Passengers carried from same	262
Total	582

Amount of freight carried to same:

	Tons.
October, 1883	300
November, 1883	400
December, 1883	600
January, 1884	400
February, 1884	400
March, 1884	300
April, 1884	300
May, 1884	200
June, 1884	200
Total in nine months	3,100

During same time freight was carried from Mosquito Inlet as follows:

Honey	lbs..	2,500
Turtles	number..	3,700
Oranges	boxes..	14,500

The schooners carried in, say, 960 tons, and took out, say, 4,000 boxes oranges.

It is estimated that from 30,000 to 40,000 boxes of oranges will be ready for shipment from here this year, and that this will constantly and steadily increase.

The bar across the mouth of the inlet is much nearer in to the shore than on any other bar that I have seen on the coast, and is only about 200 to 300 feet across. Like all the bars on the Florida coast, it is subject to great changes under the action of the storms and winds.

I made a personal examination of the inlet, and at this time there is about 8 feet of water at high water.

Captain Fulford, of the steamer Greenwich, informed me that the channel was continuously shifting in position and in depth. The usual course is a slow movement to the southward, a new channel forming along the north beach as the old channel loses itself in the south beach. I am of the opinion that it would be of great benefit could a channel

be kept, say, of 10 feet at high water over the bar. I would recommend that a survey of Mosquito Inlet be made with that end in view.

I estimate the cost of said survey at $900.

Respectfully submitted.

WM. T. ROSSELL,
Captain of Engineers.

UNITED STATES ENGINEER OFFICE,
Jacksonville, Fla., November 3, 1884.

SURVEY OF MOSQUITO INLET, FLORIDA.

UNITED STATES ENGINEER OFFICE,
Jacksonville, Fla., February 6, 1885.

GENERAL: I have the honor to transmit a report by Capt. William T. Rossell, Corps of Engineers, on the survey of Mosquito Inlet, Florida, dated January 31, 1885.

Captain Rossell submits a project of improvement involving the construction of two jetties, located as shown on the accompanying map.* The cost of these jetties, to be built only up to the level of mean low water, is estimated at from $500,000 to $750,000. It seems evident that no permanent improvement can be anticipated at this locality except by the construction of works which shall direct the ebb current in a single channel over the bar, and be so located as to protect it (the channel) from drift and wave action.

Should the interests of commerce warrant so large an expenditure as that above mentioned, some further investigations will be necessary for the proper location of the works. The proper height to be given to the jetties and the methods of construction are also to be considered. An increase in height would add greatly to the cost of the works, and it is also probable that the ultimate cost would be much increased by the additional material required to provide for settlement and injury from other causes.

Very respectfully, your obedient servant,

D. C. HOUSTON,
Lieut. Col. of Engineers, Bvt. Col., U. S. A.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

REPORT OF CAPTAIN WILLIAM T. ROSSELL, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Jacksonville, Fla., January 31, 1885.

GENERAL: I have the honor to submit the following report on the survey of Mosquito Inlet, Florida, as provided for in the river and harbor act of July 5, 1884:

This narrow passage, about 1,800 feet wide, forms the outlet for the Halifax and Hillsborough rivers, called in its upper part Mosquito Lagoon. These bodies of water extend over a distance more than 70 miles in length, and in width, vary from 1,800 feet to nearly 3 miles. The land slopes back from the banks for a distance of 3 or 4 miles, where there is a comparatively level plateau, and then slopes in the opposite direction to the valley of the Saint John's River.

The drainage area is small compared with the volume of water flowing in and out, due to the action of the tide. The rivers, so called, are

*Omitted.

more properly estuaries or arms of the sea. In measuring the width of these I have taken the distance between the high-water marks, and included the swamps which are overflowed by the high tides. These are in general covered by a thick growth of mangrove. The higher banks are covered with a fine growth of oak, on a shell hummock soil, the rock cropping out in many places; still further inland the soil is sandy and the growth fine. Along the water-fronts are many settlements, among which may be mentioned Osmond, Daytona, Port Orange, New Smyrna, and Oak Hill, varying in size and population. The largest is Daytona, with 1,000 inhabitants.

The rainfall on the water shed, as reported by the Signal Department, is from 45 to 50 inches, which is distributed unevenly throughout the year, much the greatest amount falling from June to October inclusive; least in February and most in August.

Should half the amount of water flow into the ocean through the inlet, the amount would be so small as compared with the amount flowing out at each ebb tide that we may discard this factor and assume that the strength of current in the inlet will depend on the tide alone, and will be the same, other things being equal, the year round.

But little if any sediment is brought down by the streams; the bar, then, that obstructs its entrance is a drift and wave bar.

The prevailing heavy storms on this coast come from the northeast, striking the shore here at nearly a right angle, piling up the drift material on the north side of the channel, and gradually pushing it to the south.

During long periods of comparative quiet a channel is formed nearly at right angles with the coast, with about 10 feet depth at high water; this under the action of a storm is gradually forced to the south, widens and shoals.

During the succeeding lull, a new channel will form where the old one was originally, and by the next storm is blown south, following the same course as the old one. Under these circumstances there are at times three separate channels existing at the same instant, and of necessity all shoal. After these channels come within a short distance of the southern bank they disappear, or, as the ship captains say, "are blown ashore." This shifting and shoaling of the channels is the great trouble found in the navigation of this inlet, and it is desired to form a permanent channel with not less than 10 feet depth through the inlet at high water.

The examinations recently made were intrusted to Assistant Engineer F. M. Barstow. They consisted of: (1) Soundings upon the bar with the object of ascertaining the depth of water at a sufficient number of points to answer the purpose of an estimate for jetties. (2) Determination of the amount of water flowing over the bar. (3) A few borings to determine the nature of the material of which the bar is composed.

These examinations were made during the latter part of December, 1884, and the month of January, 1885. Owing to the stormy weather during a large part of this time much was of necessity left undone which should have been attended to.

The shore line in the immediate vicinity of the inlet was located, and is shown on the accompanying map,* with the soundings taken. These soundings all referred to the plane of mean low water as observed during the examination.

The amount of discharge per second was determined in the following way:

The average rise and fall of the tide as given by the United States Coast

* Omitted.

Survey at Mosquito Inlet is 2.2 feet. On the ebb tide, near the time of low water, current observations were taken through a section marked on the chart. During this time the tide fell at the rate of one-tenth foot in ten minutes. During this time the discharge was at the rate of 38,000 cubic feet per second. The discharge, then, for ten minutes, or while the tide fell one-tenth foot, is $38,000 \times 60 \times 10 = 28,800,000$, and for a fall of 2.2 feet is $28,800,000 \times 22 = 633,600,000$ cubic feet. Again regarding the tide alone, I get from the surveys of the United States Coast and Geodetic Survey the following data:

Place.	Mean rise of tides.	Area of tide.	Volume.
	Feet.	*Square feet.*	*Cubic feet.*
Mosquito Inlet	2.2	69,696,000	153,331,200
Hillsborough River	2.4	41,817,600	219,350,000
	1.3	62,726,400	
	0.5	27,878,400	
Mosquito Lagoon	0.125	1,235,520,000	154,440,000
Halifax River (upper part)	0.5	250,905,600	125,452,800
Total			652,574,000

The areas were scaled from the Coast Survey charts of 1874–'75, and the rise of tide taken from same.

The method followed was only approximate and would not have been used had not bad weather prevented more elaborate gauging of the inlet.

The velocity differed in the different parts of the section from 0.85 foot to 3.4 feet per second, the mean for the whole section being $\frac{38000}{15500} = 2.45$ feet per second during the time of current observations.

The duration of the ebb tide is six hours and thirty minutes.

PLAN OF IMPROVEMENT.

I would recommend for this improvement the construction of two jetties and the protection of the shore line near the jetties; the jetties to be raised to the level of mean low water and to extend from mean high water to the 10-foot curve beyond the bars.

The length of the jetties will be, for north jetty 3,800 feet, and for the south jetty 2,300 feet.

I propose to build them 25 feet wide on top with side slopes of 1 on 3 on outside and 2 on 3 on inside. I propose to lay a foundation of log mattresses covered with brush, then to build up with stone of random sizes from 15 pounds to 300, to be covered with heavy blocks of concrete. The width between the jetties at the outer end to be 700 feet.*

ESTIMATE OF COST.

North jetty:		
53,000 square yards of mats, at $1.50		$79,500
20,000 cubic yards of stone, at $4		80,000
17,100 cubic yards of concrete, at $8		136,800
Total		296,300
South jetty:		
30,500 square yards of mats, at $1.50	$45,750	
14,500 cubic yards of stone, at $4	58,000	
4,000 cubic yards of concrete, at $8	32,000	
Total		135,750
Contingencies and shore protection		66,750
Aggregate		498,800

*This width between jetties cannot be fixed until further current observations are taken, but by a slight change in direction of jetties this width can be altered without adding to the cost.

I would recommend that the north jetty be built first as a protection against the northeast gales, as this might of itself give the relief asked.

My estimate is based on the belief that the stone along the banks of the river can be used in the hearting of the jetties. If it should be necessary to bring stone from the north the cost will be increased to $750,000.

A map* is inclosed showing the data obtained from the survey. This shows that at present there are three channels across the bar, and that 5½ feet is the depth available at mean low water, or 7.7 feet at mean high water. This map, as compared with the Coast Survey chart of 1875–'76, shows many changes and illustrates the shifting nature of the soil.

The borings indicate sand underlaid by a hard, stiff clay at an average depth of 20 feet below mean low water.

Further current observations will be taken. I also inclose a copy of the Coast Survey chart* showing the rivers which empty through this inlet.

COMMERCIAL STATISTICS.

From July, 1883, to July, 1884, one steamer and two schooners ran regularly through this inlet, bringing in 6,700 tons of general merchandise and taking out 20,000 boxes of oranges, 75 tons of honey, and 15 tons turtle. Within the last month a second steamer has been put on the route.

There are about 4,000 acres of oranges which would naturally send their products through this inlet. There is situated near the inlet the New Smyrna Fertilizer Company, employing one small steamer and about fifteen hands.

There is a light-house in course of construction near the inlet, to be known as the Mosquito Inlet Light.

Very respectfully, your obedient servant,

WM. T. ROSSELL,
Captain of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.
(Through Lieut. Col. D. C. Houston, Corps of Engineers, U. S. A.)

O 21.

PRELIMINARY EXAMINATION FOR CANAL AND INLAND COMMUNICATION FROM THE SAINT JOHN'S RIVER THROUGH MOSQUITO LAGOON AND INDIAN RIVER TO JUPITER INLET AND LAKE WORTH, FLORIDA.

The line of this communication leaving the Saint John's River by Pablo Creek; thence overland to North or Tolomato River to Saint Augustine Harbor; thence by Matanzas River past Matanzas Inlet; thence overland to Smith's Creek and Lalafie Creek to Halifax River, past Mosquito Inlet into Hillsborough River and Mosquito Lagoon; thence through the Haulover Canal into Indian River, Saint Lucie Sound, and Jupiter Inlet; thence overland to Lake Worth.

This remarkable line of water communication extends, as we can thus see, with but three breaks along the whole eastern coast of Florida. With the exception of the Haulover Canal, between Mosquito Lagoon and Indian River, the whole line is a natural one.

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*Omitted.

The three breaks are, 1st, Pablo Creek to Tolomato River, 10 miles; 2d, Matanzas River to Smith's Creek, 5 miles; and 3d, Jupiter Inlet to Lake Worth, 8 miles. To make the line navigable, however, in addition to these cuts, the channel would have to be deepened and straightened in many places along the natural water-way.

A report on the Haulover Canal was made by Col. Q. A. Gillmore, Corps of Engineers, U. S. A., and published as Senate Ex. Doc. No. 65, Forty-eighth Congress, first session. In this report Colonel Gillmore makes an estimate for the improvement of the canal to make it navigable for boats of 25 to 30 feet beam, and drawing 3 to 4 feet of water, at a cost of $68,800. The line between Saint Augustine Harbor and the Halifax River is now being opened by the East Coast Canal and Transportation Company to a width of 35 feet and a depth of 6 feet below mean low water. They expect to have it finished by January, 1885. Basins are to be made at intervals of from 1 to 3 miles by widening the cut to allow boats to pass each other.

The company holds a charter from the State of Florida to build and operate a canal from the Saint John's River to Key Biscayne Sound, Florida, a distance of over 400 miles, and covering the entire line of the canal and island communication from Saint John's River to Lake Worth, Florida.

Certain information concerning the route has been given me by this company through their president, Dr. J. D. Westcott, of Saint Augustine, Fla. This information is embodied briefly in a report made to me by Assistant Engineer A. W. Barber, which is appended hereto.

The establishment of a canal and inland communication from the Saint John's River, Florida, through Mosquito Lagoon and Indian River to Jupiter Inlet and Lake Worth, Florida, is in my opinion worthy of improvement.

Such a passage will furnish a continuous, well-sheltered, and economical water route for the transportation of products and merchandise for the accommodation of the people living along the whole eastern coast of Florida, from Saint John's River to Lake Worth, a distance of more than 300 miles.

The products of this section are tropical and semi-tropical, including oranges, lemons, limes, and other fruits of the citron family, pineapples, cocoanuts, and sugar-cane. At present for lack of transportation much is annually lost, and this will increase annually unless some outlet is provided. Forage, provisions, furniture, and clothing have to be brought into the country. The production of oranges is estimated between 100,000 and 200,000 boxes annually.

This line will also connect with the inside passage to Fernandina, Savannah, and Charleston.

As the East Coast Canal Company has offered the United States the use of all their maps and notes, and as these cover the line from Saint Augustine Harbor to Lake Worth with more or less accuracy, I have made two estimates. First, for the survey of whole route, $5,000; second, for survey from Saint John's River to Saint Augustine Harbor, Florida, 35 miles, $2,500.

Respectfully submitted.

WM. T. ROSSELL,
Captain of Engineers.

UNITED STATES ENGINEER OFFICE,
Jacksonville, Fla., November 3, 1884.

REPORT OF MR. A. W. BARBER, ASSISTANT ENGINEER.

JACKSONVILLE, *November* 3, 1884.

CAPTAIN: I respectfully submit the following information received through Dr. Westcott, the president of the Florida Coast Canal and Transportation Company. The charter of said company extends from Saint John's River to Biscayne Bay, a distance of about 415 miles. It is the intention of the company to complete the inland canal from Saint Augustine to Biscayne Bay first.

From Saint Augustine to the "Divides" in the Matanzas River, a distance of 12 miles, with a depth of from 30 feet to 7 feet at mean low water at the divides. From this point to Matanzas Inlet, a distance of 6 miles, with a depth at low water of from 7 feet at the divides to 16 feet in the middle, and 5 feet at or near the inlet. From Matanzas Inlet to the head of Lower Matanzas, a distance of 8 miles, with a depth at low water of from 6 feet to 2½ feet. From the head of Lower Matanzas to Smith Creek, a distance of 5 miles of solid cutting, of from 6 feet to 12 feet; one half of this is 12 feet. All cutting above 6 feet they will do with scrapers, that below with dredges. At present they have three dredges at work, and expect to have it completed to Smith Creek some time in January, 1885, and will then run stages from Smith Creek to head of Halifax River, connecting with their steamboat line. From Smith Creek to head of Halifax River, a distance of about 17 miles, with from 1 foot to 3½ feet at low water.

From head of Halifax River to Mosquito Inlet, a distance of 30 miles, with from 3 feet to 18 feet at low water; 7 miles of this distance equals 3 feet in depth. From Mosquito Inlet to Indian River Haulover Canal, a distance of 24 miles, with from 10 feet to 3 feet at low water; 6 miles of this equals 3 feet in depth. From Indian River Haulover Canal to Indian River Narrows, a distance of 70 miles, with a depth at low water of from 1 foot to 2½ feet, for 4 miles from each end; the rest of the way equals 6 to 10 feet at low water. From Indian River Narrows to Indian River Inlet, a distance of 12 miles, with an average depth at low water of 5 feet.

From Indian River Inlet to Jupiter Inlet, a distance of 45 miles, with a depth at low water of 4 feet, for one-half the way; the remainder equals 6 feet depth. From Jupiter Inlet to north end of Lake Worth, a distance of about 8 miles, with a solid cutting of 5 feet. From north end of Lake Worth to north end of Biscayne Bay, a distance of 70 miles, one-third of this distance is a solid cutting of 6 feet; the rest of the way has a depth of 2½ feet at low water.

I am, respectfully, your obedient servant,

A. W. BARBER,
Assistant Engineer.

To WILLIAM T. ROSSELL,
Captain of Engineers, U. S. A.

APPENDIX P.

IMPROVEMENT OF CERTAIN RIVERS IN THE STATES OF GEORGIA, FLORIDA, AND ALABAMA—IMPROVEMENT OF THE HARBOR AT PENSACOLA, FLORIDA.

REPORT OF CAPTAIN R. L. HOXIE, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1885, *WITH OTHER DOCUMENTS RELATING TO THE WORKS.*

IMPROVEMENTS.

1. Ocmulgee River, Georgia.
2. Oconee River, Georgia.
3. Flint River, Georgia.
4. Oostenaula and Coosawattee rivers, Georgia.
5. Coosa River, Georgia and Alabama.
6. Chattahoochee River, Georgia and Alabama.
7. Alabama River, Alabama.
8. Tallapoosa River, Alabama.
9. Cahaba River, Alabama.
10. Escambia and Conecuh rivers, Florida and Alabama.
11. Choctawhatchee River, Florida and Alabama.
12. Bayou La Grange, Florida.
13. Harbor at Pensacola, Florida.

EXAMINATIONS AND SURVEYS.

14. Outer and inner bars at the entrance of Pensacola Harbor, Florida.
15. Clearwater Harbor, Florida.
16. Upper Oconee River, Georgia, from Skull Shoals to the Georgia Railroad Bridge.

UNITED STATES ENGINEER OFFICE,
Montgomery, Ala., August 2, 1885.

GENERAL: I have the honor to forward herewith annual reports upon the river and harbor improvements under my charge for the fiscal year ending June 30, 1885.

Very respectfully, your obedient servant,

R. L. HOXIE,
Captain of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

P 1.

IMPROVEMENT OF THE OCMULGEE RIVER, GEORGIA.

The Ocmulgee River rises in the northwestern part of Georgia, flows past the towns of Macon, Ga., and Hawkinsville, Ga., and unites with the Oconee River about 10 miles below Lumber City to form the Altamaha. The State of Georgia has expended about $60,000 for the im-

provement of this river. The first examination and survey by authority of the United States was made in 1852, and another in 1875. Subsequent to this a plan of improvement was adopted which contemplates the removal of obstructions from the channel, and cutting through rock shoals so as to obtain a navigable channel 60 feet in width and 4 feet in depth at low water from Macon, Ga., to the Oconee River.

The work done up to the present time under the adopted plan of improvement has resulted in securing navigation of the river at a stage from 2 to 3 feet lower than was practicable before the commencement of the improvement, enabling boats to run during seasons in which they were formerly tied up.

During the past fiscal year the snag-boat belonging to this improvement was thoroughly repaired, but was kept at work until the 15th of June on the Oconee River in connection with the snag-boat for that river. The appropriation for each of these rivers being so small it was thought best to concentrate the working plant of both rivers upon each in succession in order to reduce the cost of engineering, superintendence, and contingencies. On June 15 operations were commenced at Big Eddy, near Jacksonville, securing at that point a channel 80 feet wide by 10 feet deep at low water, where formerly existed one of the most troublesome places to navigation on this portion of the river. The Oconee boat will be sent to join the Ocmulgee boat in the latter part of July, so that the two may be worked together during the low-water season on the Ocmulgee River, as was done last season on the Oconee.

The balance of appropriation remaining on hand, together with appropriation asked for, can be profitably expended in continuing the work of improving the river channel.

Near Lumber City, Ga., the East Tennessee, Virginia and Georgia Railroad crosses the Ocmulgee River on a bridge having a draw-span, of which but one opening is available for navigation, and this has a width, at low water, of 40 feet, with good approaches above and below; in time of freshets cross-currents in this channel render caution necessary in passing it. No complaint is made by steamboat men, but whenever the bridge is rebuilt or extensively repaired the pivot pier should be shifted in position so as to give a clear span of 75 feet over the best portion of the river channel.

About one-half mile above Hawkinsville the same railroad crosses the Ocmulgee River on a wooden Howe truss bridge about 25 feet above low water, and without a draw. This bridge will be an obstruction to navigation, as the improvement of the river is in contemplation as high up as Macon, Ga. The remedy is the introduction of a draw-span with not less than 60 feet clear opening.

About 6 miles below Macon the same railroad again crosses the Ocmulgee River on a wooden Howe truss bridge, reported to be about 15 feet above low water. This will prove an obstruction to navigation when the river is improved as far as Macon, Ga., and a draw-span should be put in with not less than 60 feet clear width.

This work has been in charge of Assistant Engineer C. A. Locke.

The funds on hand will be exhausted before the close of the present working season. The appropriation asked for is barely sufficient to pay the running expenses of the snag-boat and maintain one party at lock excavation on the reefs. If a less amount than that asked for be appropriated the working plan will suffer the consequences of deterioration from disuse.

Money statement.

July 1, 1884, amount available		$12 14
Amount appropriated by act approved July 5, 1884		3,000 00
		3,012 14
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilites July 1, 1884	$635 53	
July 1, 1885, outstanding liabilities	384 03	
		1,019 56
July 1, 1885, amount available		1,992 58
Amount (estimated) required for completion of existing project		30,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		15,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

COMMERCIAL STATISTICS.

The following-named steamboats have been employed in the navigation of this river during the past fiscal year:

	Tons.
Ida	296
Colville	83
Mary Jeter	60
Wadley	190
Mary Cooper	150
North State	180
Cumberland	275

These boats have carried about 6,800 barrels turpentine, 28,000 barrels rosin, and about 3,200 tons of cotton, provisions, &c. In addition to this, about 30,000,000 feet of lumber (B. M.) has been rafted down the river.

P 2.

IMPROVEMENT OF OCONEE RIVER, GEORGIA.

This river rises in Northeast Georgia, flows past Milledgeville and Dublin, Ga., and joins the Ocmulgee in the southern part of the State, forming the Altamaha. The State of Georgia has expended about $35,000 for its improvement. The first examination of the river by authority of the United States was made in 1874, and a plan of improvement adopted contemplating the removal of obstructions from the channel, and blasting through rock reefs where necessary in order to secure a depth of about 3 feet at low water from Milledgeville to the Ocmulgee River. The work done up to the present time under this plan of improvement, at an expenditure of $23,459.36, has resulted in enabling steamboats to navigate the river at a stage of water 4 feet lower than that at which navigation was practicable before the improvement was commenced. During the past fiscal year the work done consisted in cutting a channel through the rock reefs at Chaney's Shoal, near the river's mouth, and removing snags and other obstructions between this point and a point 15 miles above Dublin. The limited appropriation available was supplemented by a donation from the Oconee River Steamboat Company of $300, which enabled the work to be recommenced and prosecuted for a short time this summer; otherwise the cost of the very extensive repairs required by the snag-boat would have prevented any work this season. This boat is old and rapidly becoming useless, and unless liberal appropriations are made at once the working plant for this river will have been worn out without performing adequate service, because of inadequate appropriations heretofore.

The removal of obstructions from McLeod's Cut-down, a distance of 28

miles, has given about 2 feet greater depth of channel where these obstructions existed.

The balance of appropriation remaining on hand, together with the appropriation asked for, can be profitably expended in continuing the work of improving the river channel.

A wooden Howe truss bridge of the Central Railroad of Georgia crosses this river about 30 miles above Dublin, the present head of navigation. As the improvement of the river above this point is in contemplation, this bridge, which is reported to be about 25 feet above low water and without a draw, will be an obstruction to navigation. The remedy should be the building of a draw next the right bank of the river with not less than 60 feet clear span.

This work has been in charge of Assistant Engineer C. A. Locke.

The funds available on July 1, 1885, are not sufficient to justify the continuance of the work, and the working plant must be laid up or employed elsewhere during the coming fiscal year. The amount asked for for the fiscal year ending June 30, 1887, will barely suffice to pay the expenses of working the snag-boat and keeping one party at work on rock excavation. If a less amount than that asked for be appropriated the working plant will suffer the consequences of deterioration from disuse.

Money statement.

July 1, 1884, amount available		$472 24
Amount appropriated by act approved July 5, 1884		3,000 00
		3,472 24
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$3,120 02	
July 1, 1885, outstanding liabilities	311 58	
		3,431 60
July 1, 1885, amount available		40 64
Amount (estimated) required for completion of existing project		30,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		15,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

The following steamboats are employed upon this river:

	Tons.
Laurens	180
Wadley	190
Ida	250
Mary Cooper	150
North State	180

These boats have carried during the past year about 4,400 barrels turpentine, 17,000 barrels rosin, and about 6,000 tons cotton, merchandise, provisions, &c., besides which about 20,000,000 feet of lumber have been rafted down the river.

P 3.

IMPROVEMENT OF FLINT RIVER, GEORGIA.

This river rises in Western Georgia near the city of Atlanta. It flows past Montezuma, Albany, Newton, and other towns to Chattahoochee, Fla., where it unites with the Chattahoochee to form the Apalachicola River. The plan of improvement, made pursuant to an examination and survey of the river in 1872 and 1873, modified after further examination in 1880, contemplates a low-water navigable channel 3 feet in depth and 100 feet in width, from the mouth of the river to Albany,

Ga., a distance of 105 miles, and a navigable channel for light-draught steamers at a moderate stage of water from Albany to Montezuma, an estimated distance of 100 miles. The work to be done consists of the removal of snags and other obstructions from the channel and overhanging trees from the banks, the securing of bars by works of contraction, and cutting of the prescribed channel through the rock reefs.

The expenditure up to the present time of $84,373.76 has resulted in securing a fair navigable channel at low water from Chattahoochee to Fergurson's Shoals, about 20 miles below Albany, where the work of cutting through the rock reefs is now progressing, and an improved high-water channel between Montezuma and Swift Creek, near the town of Warwick, about 40 miles above Albany.

During the past fiscal year a small hand-power snag-boat was kept at work on the river between Montezuma and Swift Creek removing logs and cutting overhanging trees, effecting the removal of 12,961 snags and overhanging trees; and a number of drilling scows on the reefs about 20 miles below Albany were engaged in effecting the removal of 2,202 cubic yards of rock over a distance of 18½ miles. In addition to this the latter party removed all of the snags and overhanging trees that were found in this section of the river.

The following table shows the condition of the improvement on June 30, 1885:

Table showing condition of improvement on the 30th day of June, 1885.

Names of places.	Number of shoals.	Above Chattahoochee, Fla.	Below Albany, Ga.	Original depth.	Present depth.	Original width.	Present width.	Remarks.
		Miles.	*Miles.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	
Lambert's Island	1	23	88	1	3	60	100	New channel opened.
Rob's Rock	2	26	85	0	2	50	100	Dry bowlder blasted.
Broad-Axe Rock	3	26½	84½	½	4	70	100	Bowlder in mid-channel removed.
Bryant's Rock	4	31½	79½	½	4	50	100	Bowlder on point removed.
Versailles Rock	5	34	77	½	4	100	100	Bowlder in mid-channel removed.
Bainbridge	6	36	75	1	4	40	100	Several reefs removed.
Three-Rock Reach	7	39	72	½	4	40	100	Loose rock removed.
Below X Chute	8	40	71	½	4	30	100	Do.
X Chute	9	47	64	0	4	75	100	Dry ledge blasted to widen channel.
Fodderstack	10	48	63	0	3	80	100	Do.
Reefs 1 to 12	11 to 22	48 to 57	63 to 54	1	3	40	100	Loose rocks and solid ledges removed.
Crawford's Point	23	57	54	0	3	70	100	Dry ledge blasted and removed.
Winding Shoals	24	58	53	1	3	40	100	Dry ledge blasted and loose rock removed.
Hell Gate Shoals	25	59½	51½	0	3	0	100	New channel blasted and dam built.
Sycamore Shoals	26	60	51	1	3	40	100	Loose rock and solid ledges blasted.
Maple's Chute	27	60½	50½	0	3	20	100	Cut-off made and new channel blasted.
Keaton's, lower	28	62¼	48¾	0	3	20	100	Loose rock and solid ledges blasted.
Keaton's, middle	29	62½	48½	0	3	20	100	Do.
Keaton's, upper	30	62¾	48¼	0	3	0	75	Do.
Dubignion's	31	63	48	0	3	0	90	Do.
Lyon's Island	32	67	44	2	3	0	75	Loose rock and bowlders removed.
Fish Trap Shoals	33	67½	43½	2	3	0	100	Two solid reefs removed.
Bull's Slough	34	69½	41½	1½	3	0	100	Loose rock and solid ledges blasted.
Rope Work Shoals	35	70	41	1	4	50	50	Do.
Drybread Reef No. 3	36	71	40	0	5	25	75	Do.
Drybread Reef No. 2	37	71½	39½	2	3	20	80	Do.
Drybread Reef No. 1	38	72	39	3	5	20	80	Do.
Dickerson's Shoals	39	72½	38½	2	3	40	80	Loose rock and bowlders blasted.
Buck Shoals	40	74	37	2	3	30	80	Do.
Sister's Islands, three reefs.	41	74¾	36¼	2	3	40	80	Do.
Kenedy's Island	42	76¾	34¼	2	3	30	75	Do.
Newton	43	77¾	33¼	2	3	40	100	Do.
Odom's Rocks	44	79¾	31¼	3	3	40	80	Do.
Fergurson's Shoal	45	88½	22½	1	.....	.....	.....	

The amount of funds on hand and the appropriation asked for can be profitably expended in continuing the improvement, according to the project, on both sections of the river.

The navigation of this river is obstructed at a point 30 miles below Montezuma, and opposite the town of Dayton, by a lattice wagon-bridge, which contains no draw and is not at a sufficient elevation. The remedy is the introduction of a draw of suitable width, with sheer booms if necessary. Within the corporate limits of the town of Albany three bridges cross the river, namely, Brunswick and Western Railroad Bridge; the Savannah, Florida and Western Railroad Bridge, and a wooden lattice wagon-bridge. The remedy in each case is the introduction of a draw of suitable width, with sheer booms if necessary. Opposite the town of Bainbridge an iron bridge with a draw crosses the river, and may require the use of sheer booms after navigation has been opened to Albany.

This work has been in charge of Assistant Engineer P. M. Slaughter.

The funds on hand will be exhausted during the present working season. The appropriation asked for is barely sufficient to pay the running expenses of the snag-boat and maintain one party at rock excavation on the reefs.

Should a less amount than that asked for be appropriated the working plant will suffer the consequences of deterioration from disuse.

COMMERCIAL STATISTICS.

Replies to requests for information under this head have not yet been received, but it appears from last year's report that during the fiscal year ending June 30, 1884, there were eight steamboats employed in the navigation of this river, having an aggregate capacity of 5,350 bales of cotton, and that freights were carried by these boats on this river below Bainbridge, during the same year, aggregating in value $3,234,163. The value of freights carried in 1883 was slightly in excess of this.

Money statement.

July 1, 1884, amount available		$610 11
Amount appropriated by act approved July 5, 1884		20,000 00
		20,610 11
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$6,190 60	
July 1, 1885, outstanding liabilities	1,793 27	
		7,983 87
July 1, 1885, amount available		12,626 24
Amount (estimated) required for completion of existing project		110,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		20,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

P 4.

IMPROVEMENT OF THE OOSTENAULA AND COOSAWATTEE RIVERS, GEORGIA.

No work has been done on either of these streams during the fiscal year, nor in fact since actual operations were suspended on the Coosawattee in October, 1880, and on the Oostenaula in August, 1881.

There is now little, if any, commerce on either of these streams, though parties are talking of putting a small steamboat on the Oostenaula.

As there is now a fair channel for light navigation at moderate stages

of the water, no further appropriation appears to be demanded by the interests of commerce.

Money statement.

July 1, 1884, amount available	$1,163 71
July 1, 1885, outstanding liabilities	21 85
July 1, 1885, amount available	1,141 86

P 5.

IMPROVEMENT OF THE COOSA RIVER, GEORGIA AND ALABAMA.

In 1823 the State of Alabama passed an act to aid the improvement of the Coosa river. In 1828 Congress provided that any surplus of the grant for the Tennessee River should be applied to the improvement of the navigation of the Coosa and other rivers. In 1870 an act of Congress authorized an examination of the Coosa River between Greensport and the Selma, Rome and Dalton Railroad Bridge, a distance of 77 miles, and in 1872 an instrumental survey of this part of the river, upon which to base plans and estimates for its improvement. In 1875 an examination of the river was made from Rome, Ga., to Gadsden, Ala., a distance of 135 miles, when a plan for its improvement was adopted, which was subsequently modified, providing for a channel 80 feet wide and 4 feet deep at extreme low water.

In 1876 an appropriation was made for improving the Coosa River between Rome and the Selma, Rome and Dalton Railroad Bridge, which dates the beginning of the improvement of this river according to the present project. This project contemplates the improvement of the river between these points, overcoming the more serious obstructions by locks and dams, and the lesser rock shoals and sand and gravel bars by rock excavation and by works of contraction respectively. This plan has been carried out to the present time without material change or modification.

This river has been navigated continuously between Rome and Greensport since 1847, during high water, a distance of about 180 miles, the obstructions consisting of the lesser shoals and bars. Just below Greensport the Ten Island Shoals offered a more serious obstruction, giving a fall at low water of 24 feet in a distance of about 2 miles.

The work done up to the present time has resulted in the improvement of the low-water channel above Greensport by straightening it and widening it, and increasing the depth from 16 inches to a minimum of 2 feet. Below Greensport the work of lock and dam navigation, to overcome the more serious obstructions, is nearly completed. This will open the river to navigation as far down as the head of Broken Arrow Shoal, and will be completed during the present summer.

The result up to the present time has been the improvement of the navigation of the river above Greensport, but the most important results will follow the completion of the improvement to the Selma, Rome and Dalton Railroad Bridge. This will give access to 75 miles of the river, on the borders of which is a new section of territory surpassing in its natural resources any section of the upper river; it is rich in coal, iron-ore, timber, and building material, and in its agricultural productions will compare favorably with other sections. The work done upon this river during the past working season has been confined to the locks

and dams at Ten Island Shoals, and the excavation of a channel through the reefs in this vicinity, excepting a few weeks' work in the removal of loose rock and cutting overhanging timber above Greensport. A detailed survey has been made for the location of Lock 4 and dam, and the completion of the work of excavating a channel through the rock-reefs down to Riverside, where the Georgia Pacific Railroad crosses the Coosa River.

The quantities of work are as follows:

Stone quarried	cubic yards..	5,077
Stone cut	do....	1,286
Stone built into lock, masonry	do....	4,406
Stone built into dry rubble dams	do....	1,922
Channel excavation (solid rock)	do....	790
Lock-pit excavation (solid rock)	do....	2,303
Lock-pit excavation loose rock and gravel	do....	3,455
Earth excavated from quarries, abutments, &c	do....	9,846
Timber hewn for miter-sills	feet B. M..	10,080
Timber framed for lock-gates	feet..	36,086

Work upon Lock 3 could not be commenced until late in the season, owing to the difficulty of obtaining title to the land.

The condition of the work on June 30, 1885, was as follows:

Lock No. 1.—Lock and dam completed and gates set up.

Lock No. 2.—Lock and dam completed and gates framed.

Lock No. 3.—Lock (except coping) and dam completed and gates framed.

Lock No. 4.—Stone will be quarried and cut, except the coping, in about two weeks.

The East and West Alabama Railroad Bridge crosses the Coosa River 1 mile below Lock 3; it is an obstruction to navigation, being of insufficient height for boats to pass under it, and having no draw. It should be modified by the construction of a draw.

The Georgia Pacific Railroad Bridge crosses the Coosa River at Riverside, 5 miles below Lock 4; it is an obstruction to navigation, being of insufficient height for boats to pass under it, and having no draw. It should be modified by the construction of a draw.

This work has been in charge of Assistant Engineer Mr. T. Singleton.

It is estimated that the funds remaining on hand July 1, 1885, will have been expended before the close of this working season.

If a less amount than asked for be appropriated, the working plant will suffer the consequences of deterioration from disuse.

Money statement.

July 1, 1884, amount available		$36,093 44
Amount appropriated by act approved July 5, 1884		50,000 00
		86,093 44
July 1, 1885, amount expended during fiscal year exclusive of outstanding liabilities July 1, 1884	$64,231 32	
July 1, 1885, outstanding liabilities	13,653 24	
		77,884 56
July 1, 1885, amount available		8,208 88
Amount (estimated) required for completion of existing project		150,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		150,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

The following is a list of the boats now employed on the river:

Name.	Length at water-line.	Beam.	Tonnage.
	Feet.	*Feet.*	
Sidney P. Smith	137	23	83.40
Gadsden	164	30	133.66
Joel Marable	140	20	97.75
Hill City	140	18	75.75
To be completed by September 15, 1885	175	34	250.00

During the year ending June 30, 1885, these boats carried freight as follows:

Cotton	bales..	25,000
Grain, hay, and flour	tons..	3,500
Guano	do...	2,500
Miscellaneous merchandise	do...	5,000
Lumber	feet B. M..	4,500,000
Passengers	number..	8,500

In addition to the above, about 24,000,000 feet B. M. yellow-pine lumber was rafted to the mills on the river.

P 6.

IMPROVEMENT OF THE CHATTAHOOCHEE RIVER, GEORGIA AND ALABAMA.

The Chattahoochee River rises in the northern part of Georgia, flowing past the town of Columbus, the proposed head of navigation, where the river forms the boundary line between Georgia and Alabama, the town of Eufaula, Ala., and other towns, to Chattahoochee, Fla., where it unites with Flint River to form the Apalachicola. The present plan of improvement, adopted in 1873, contemplates a low-water channel, 4 feet in depth and 100 feet in width, from Columbus, Ga., to Chattahoochee, Fla., a distance of 162½ miles, by the removal of snags and other obstructions from the channel and overhanging trees from the banks by cutting a channel through the rock shoals and deepening sand-bars by scour.

The expenditure up to the present time of $174,146.17 has resulted in securing a fair navigable channel between Chattahoochee and Eufaula at all seasons of the year, and between Eufaula and Columbus at all times except during the prevalence of extreme low water.

The following table exhibits the condition of the improvement on June 30, 1885:

Table exhibiting condition of the improvement on June 30, 1885.

Number of shoal.	Name of place.	Below Columbus, Ga.	Above Chattahoochee, Fla.	Original depth.	Present depth.	Original width.	Present width.	Remarks.
		Miles.	*Miles.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	
1	South Commons	1	223	2	4	300	100	Brush jetties.
2	Mound Bar	7	217	2½	4	350	150	Do.
3	Abercrombie's Bar.....	8	216	1½	4	350	150	Do
4	Wolfolk's Bar	10	214	1½	4	500	150	Brush jetties and shore protection.
5	Upatoie Bar	11	213	2	4	300	150	Brush jetties.
6	Little Uchee Shoal.....	17	207	2	4	29	65	Marl reef blasted and removed.
7	Reef below shoal	17½	206½	1½	4	50	60	Do.
8	Slick Bluff Shoal	18	206	0	4	39	70	Do.
9	Middle Rock	18½	205½	1½	4	30	100	Do.
10	Big Uchee Shoal	19	205	1½	4	29	65	Do.
11	Old Head of Uchee ...	19½	204½	1½	4	40	.....	Now in process of completion.
12	Belton's Upper Rocks ..	20½	203½	0	4	40	180	Hard rocks blasted and removed.
13	Belton's Lower Rocks ..	21	203	0	4	50	200	Do.
14	Cody's Rocks	22	202	1	4	40	100	Do.
15	Shell Creek Bar	24	200	3	3	350	350	Shore protection.
16	Culpepper's Island.....	32	192	2	4	400	100	Jetties and marl reef removed.
17	Sardredge's Shoal.....	112	112	2	4	35	100	Hard rocks blasted and removed.

Nos. 6, 7, 8, 9, 10, 11 constitute Uchee Shoals, about 3 miles long; No. 11 now being worked on.

During the past fiscal year the steam snag-boat was kept at work until September 17, when she was run ashore to keep her from sinking, having rotted out her second hull on this work. The engines and machinery were carefully removed and stored, and arrangements have been made for putting them into a new hull, which will be ready for work next season.

Over 1,100 snags, logs, and trees were removed from the channel, as well as the wrecks of two steamers and one flat-boat. The principal work done has been the excavation of a channel through Uchee Shoals, where 3,764 cubic yards of rock have been removed, the distance worked at that point being 3,000 feet.

The balance of appropriation remaining on hand, together with the appropriation asked for, can be profitably expended in continuing the work of improving the channel.

It is reported that the improvement of navigation of this river has resulted in reducing the rate of cotton transportation to $1.50 per bale from Columbus to New York by way of Chattahoochee and Fernandina.

Two bridges cross this river at the town of Eufaula, which, during high water, are obstructions to navigation. One of these is a lattice wagon-bridge and the other the Southwestern Railroad Bridge. The remedy in each case is the introduction of a draw of suitable width, with sheer-booms if necessary. At the town of Fort Gaines, 35 miles below Eufaula, a lattice wagon-bridge crosses the river, which is an obstruction to navigation in high water. The remedy is the introduction of a draw of suitable width, with sheer-booms if necessary.

This work has been in charge of Assistant Engineer P. M. Slaughter.

The funds on hand will be exhausted during the present working season. The appropriation asked for is barely sufficient to pay the running expenses of the snag-boat and maintain one working party at rock excavation on the reefs.

If a less amount than that asked for is appropriated the working plant will suffer the consequences of deterioration from disuse.

COMMERCIAL STATISTICS.

The information asked for under this head has not been received. The statistics of last year show that eight steamboats, having an aggregate capacity of 5,350 bales of cotton, were employed in the navigation of the river during the year ending June 30, 1884, and the amount of cotton transported on the river since the commencement of the improvement had increased from 8,415 bales in 1874 to 23,160 bales in 1883; that in 1884 the value of merchandise &c., transported on the river was $7,479,144, as against $6,919,362 in 1883 and $3,760,000 in 1879.

Money statement.

July 1, 1884, amount available		$9,046 62
Amount appropriated by act approved July 5, 1884		35,000 00
		44,046 62
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$13,309 18	
July 1, 1885, outstanding liabilities	1,883 61	
		15,192 79
July 1, 1885, amount available		28,853 83
Amount (estimated) required for completion of existing project		120,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		20,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

Commerce of Chattahoochee and Flint rivers for year ending June 30, 1885.

Items.	Chattahoochee River.		Flint River.	
	Quantity.	Value.	Quantity.	Value.
Steamers (number, 6; tonnage, 1,087; draught, 3 to 5 feet)	.....	$87,400	.....	$87,400
Fertilizers ..... tons	8,092	364,060	4,890	220,050
Iron ..... do	245	18,600	190	15,200
Cotton ..... bales	45,620	1,870,420	18,640	764,240
Grain ..... bushels	162,380	178,618	25,200	27,720
Lumber ..... feet	340,000	6,800	2,120,000	42,400
Merchandise ..... bales	2,420	181,500	923	69,215
Merchandise ..... barrels	530,600	4,244,800	225,600	1,804,800
Live stock ..... number	394	59,880	53	8,056
Cotton up to the compress ..... bales	2,050	84,050	.....	.....
Cotton down from compress ..... do	19,420	796,220	.....	.....
Freights to boats	.....	102,600	.....	51,400
Passage to boats	.....	38,400	.....	3,800
Aggregate amount of river business	.....	7,945,948	.....	3,006,881

Total amount business for both rivers	$10,952,829
Total value in 1882*	11,460,084
Total value in 1883*	10,563,434
Total value in 1884*	11,140,587
Total value in 1885*	10,952,829

While the aggregate of river's business is really less than last season there is an apparent increase which was caused by the construction and use of a compress for the river cotton, and shipment of same by river to railroad points below, which was made possible by the improved condition of the Chattahoochee River.

C. E. HOCHSTRASSER,
Vice-President Columbus Board of Trade.
E. L. WELLS,
Secretary Columbus Board of Trade.

COLUMBUS, GA., *July*, 1885.

* Includes Apalachicola River, Florida.

P 7.

IMPROVEMENT OF ALABAMA RIVER, ALABAMA.

This stream is formed by the junction of the Coosa and the Tallapoosa rivers, in the vicinity of Montgomery Ala., in the central portion of the State, and flows southward past the town of Selma, uniting with the Tombigbee to form the Mobile River, which empties into Mobile Bay. This river, with its principal tributary, the Coosa, now under improvement, offers a continuous line of water transportation from Rome, Ga., to the Gulf of Mexico, flowing through the coal and iron deposits of Alabama and the cotton belt.

The plan of improvement for the Alabama River, adopted in 1876, contemplates a channel 200 feet in width and 4 feet in depth at low water from its mouth, 50 miles above Mobile, Ala., to Wetumpka, Ala., a distance of 323 miles. Before the improvement was commenced the channel had a least depth of about 2 feet on some of the shoals, and was badly obstructed by snags and overhanging trees.

The expenditure up to June 30, 1885, of $125,092.03 has resulted in opening 20 miles of the lower river below the cut-off, before inaccessible during low water, and rendering that part of the river below Montgomery easy of navigation during ordinary low water.

During the past fiscal year but little work could be done except the pulling of snags and logs washed in since the previous season over the worst portion of the river, the appropriation being insufficient for the further extension of the work of improvement. An excellent working plant for this river is on hand, and with sufficient appropriations can be made to do effective work. In the absence of such appropriations this plant will decay before any adequate return has been had for the expenditure in providing it. The work done was principally between Montgomery and Selma, in the vicinity of Gardner's Island.

It is proposed to expend the funds remaining on hand and the appropriation asked for in the further improvement of the river channel and in the maintenance of the work already done in accordance with the plan of improvement adopted.

A wagon-bridge crosses this river at the town of Selma; it is provided with a draw-span, having one available opening for navigation. The location of the bridge and of the draw-span are badly chosen, and the draw seems to require supplementary works to assist the passage of boats through it. This matter is under consideration by a Board of Engineers appointed for this purpose.

The funds now available will be exhausted before the close of the present working season. The appropriation asked for is barely sufficient for paying the running expenses of the present working plant for preserving the work which has already been done and maintaining a small working party in continuing the improvement of the river.

If a less amount than that asked for be appropriated the working plant will suffer the consequences of deterioration from disuse.

COMMERCIAL STATISTICS.

From four to seven steamboats are employed in the commerce of this river, and the value of the merchandise carried is from $4,000,000 to $5,000,000. With the opening of the Cahaba and the Coosa rivers to the coal-fields and the Tallapoosa to the mills and fine water-power at Tallassee, the completion of the improvement of the river will afford facilities for a greatly increased commerce.

Money statement.

July 1, 1884, amount available		$2,567 18
Amount appropriated by act approved July 5, 1884		10,000 00
		12,567 18
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$6,563 42	
July 1, 1885, outstanding liabilities	1,095 79	
		7,659 21
July 1, 1885, amount available		4,907 97
Amount (estimated) required for completion of existing project		100,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		20,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

P 8.

IMPROVEMENT OF TALLAPOOSA RIVER, ALABAMA.

This river rises in the northwestern part of Georgia and flows in a southwesterly direction past the town of Tallassee to the Alabama River, a short distance below Wetumpka. It has a fine water-power at Tallassee which has been partially utilized by mills at that point, and below this flows through a fine agricultural country. The plan of improvement adopted pursuant to an examination and partial survey of this river made by an act of Congress approved June 14, 1880, contemplates obtaining a navigable channel from the mouth of the river to the foot of the Tallassee Reefs, 2 miles below the town of Tallassee, a distance of 48 miles, with a least depth of 3 feet and width of 60 feet at low water. This is to be accomplished by the removal of snags, logs, &c., from the channel, cutting overhanging trees from the banks, and the cutting of the prescribed channel through the rock reefs and the removal of bars by works of contraction.

The expenditure up to June 30, 1885, of $18,713.44, has resulted in the partial improvement of the channel in the lower portion of this river, but the work has not progressed sufficiently to effect navigation.

During the past fiscal year the work was carried on for a limited time with the snag-boat belonging to the Noxubee improvement, but this being required for the latter stream the work had to be suspended, and a snag-boat with steam capstan and powerful sheers and tackle was constructed for use on the Tallapoosa.

It is proposed to apply the amount on hand and the appropriation asked for to the continuation of this improvement in accordance with the approved plan.

The amount now available will be exhausted before the close of the present working season. The appropriation asked for will barely suffice to pay the running expenses of the snag-boat and maintain a small party at rock excavation and other work on the improvement.

If a less amount than that asked for be appropriated the working plant will suffer the consequences of deterioration from disuse.

COMMERCIAL STATISTICS.

It is not known that any vessels have been employed in the navigation of this river during the past fiscal year. It has been estimated

that the improvement of the river will furnish transportation for cotton and merchandise to the value of about $1,700,000, and probably more, should the improvement of the river lead to the full development of the water-power at Tallassee.

Money statement.

July 1, 1884, amount available		$6,562 08
Amount appropriated by act approved July 5, 1884		10,000 00
		16,562 08
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$9,481 28	
July 1, 1885, outstanding liabilities	794 24	
		10,275 52
July 1, 1885, amount available		6,286 56
Amount (estimated) required for completion of existing project		30,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		15,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

P 9.

IMPROVEMENT OF CAHABA RIVER, ALABAMA.

This river rises in the northwestern part of Alabama, flows in a southerly direction past the town of Centerville and through the Cahaba coal and iron district to the Alabama River at Cahaba. The principal object of its improvement is the development of the waterway for the output of the Cahaba coal and iron district. The plan of improvement, adopted in 1883, contemplates a channel 60 feet in width and 3 feet in depth at low water from its mouth to the town of Centerville, a distance of 88 miles, by the removal of all obstructions from the channel, cutting through the rock reefs, scouring bars and cutting overhanging trees.

The expenditure up to June 30, 1885, of $25,477.13 has resulted in the partial improvement of the river from its mouth to Centerville, deepening it to high water navigation. This is within a distance of 21 miles of Cane Creek, which is within the Cahaba coal fields. For this section of the river lock and dam navigation is proposed.

During the past fiscal year the working plant which had been employed on this river was transferred to the Tallapoosa for a short time, and then to the Noxubee River, to which improvement it belongs, so that no work was done on the Cahaba. A snag-boat with steam capstan and powerful shears and tackle has been constructed for the use of this river improvement and will be employed on the river during the present working season.

It is proposed to apply the funds available and the appropriation asked for in continuing the work of improvement in accordance with the adopted plan.

Navigation is obstructed by the Selma and New Orleans Railroad Bridge at a point about 8 miles above the mouth of the river, and by the Alabama Central Railroad Bridge at a point about 21 miles above its mouth. Each of these bridges has been built without a draw, and the remedy in each case is the provision of a suitable draw with opening sufficient for navigation and with sheer-booms if necessary.

The funds now available will be exhausted before the close of the present working season. The appropriation asked for is barely sufficient for paying the running expenses of the snagboat and maintaining a small party at rock excavation and other work. If a less amount than that asked for be appropriated the working plant will suffer the consequence of deterioration from disuse.

COMMERCIAL STATISTICS.

It is not known that any vessels have made use of this river during the past fiscal year except the Captain Sam, a small steamboat which was run for a limited time and then transferred to the Alabama River, where she was blown up by a boiler explosion. It has been estimated that the improvement of this river will furnish transportation for cotton and merchandise to the value of about $3,870,000, and that the saving to the planters adjacent to the river, on their cotton crops alone, will be $60,000 annually; that with slackwater navigation above Centerville to Cane Creek, the main business of the river will result from the development of the immense coal, iron, and timber interests of the Cahaba Valley, but that this development will require an extension of the river improvement by a system of slackwater navigation from Centerville to Cane Creek, a distance of 21 miles.

Money statement.

July 1, 1884, amount available		$2,624 71
Amount appropriated by act approved July 5, 1884		10,000 00
		12,624 71
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$7,426 74	
July 1, 1885, outstanding liabilities	675 10	
		8,101 84
July 1, 1985, amount available		4,522 87
Amount (estimated) required for completion of existing project		165,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		15,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

P 10.

IMPROVEMENT OF ESCAMBIA AND CONECUH RIVERS, FLORIDA AND ALABAMA.

Under the name of Conecuh River this stream rises in the southeastern part of Alabama and flows past the towns of Andalusia, Brewton, and Pollard to the Florida State line, where the name changes to Escambia River, and the stream continues southward to Pensacola Bay. It flows through a very extensive lumber district of long-leaf yellow pine, contributing largely to the export trade of Pensacola.

The plan of improvement for this river adopted pursuant to partial examinations and surveys made in 1878–'79, contemplates the removal of snags and sunken logs and other obstructions from the channel, closing cut-offs, and cutting through the rock shoals from the mouth of the river in Pensacola Bay to Indian Creek a distance of 273 miles, for the

purpose of facilitating the movement of logs and rafts down the river, affording at the same time facilities for steamboat navigation.

Up to June 30, 1885, the expenditure of $31,136.57 has resulted in dredging a channel through the bar at the mouth of the river and in the removal of obstructions to navigation, so that at the present time the river is navigable at ordinary stages of water for steamboats drawing 5½ feet of water from Ferry Pass to Skinner's Landing, a distance of 17 miles, and for boats drawing 3 feet to the Alabama State line. Above this point the channel has been improved sufficiently to give increased facilities to the commerce of the river.

During the fiscal year ending June 30, 1885, the work done consisted in the removal of snags and other obstructions from the river channel, and of overhanging trees from the banks over a distance of about 71 miles, including the revision of former work. In all 15,472 logs, snags, stumps, &c., have been cut or removed; the work done was principally in the upper river, known as the Conecuh, about 5½ miles of the Escambia only being revised. The snag-boat was equipped with a steam pile-driver for more effective service. This is a work which will require constant attention and continual appropriations, fresh obstructions being brought in annually by the freshets of winter and spring.

It is proposed to apply the funds remaining on hand and the appropriations asked for to the continuation of the work of river improvement in accordance with the adopted plan.

This work has been in charge of Assistant Engineer Hiram Haines.

The funds available will be exhausted before the close of the present working season. The appropriation asked for will barely suffice to pay the running expenses of the snag-boat and maintain one additional party for the improvement of the rock shoals and general service on the upper river.

If a less amount than that asked for be appropriated the working plant will suffer the consequences of deterioration from disuse.

COMMERCIAL STATISTICS.

During the fiscal year ending June 30, 1885, this stream has carried down 2,793,000 cubic feet of sawn timber, 1,812,000 cubic feet of hewn timber, and 50,000 saw-logs of yellow pine, cypress, cedar, white oak, and poplar, the estimated aggregate value of which is $600,000. A small steamboat, the Ida Stockton, has made several trips on the river as far up as Andalusia, carrying up provisions and miscellaneous merchandise and returning with cotton, country produce, &c. Preparations are being made to start another steamboat in this trade during the coming winter.

Money statement.

July 1, 1884, amount available		$592 80
Amount appropriated by act approved July 5, 1884		15,000 00
		15,592 80
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$6,350 57	
July 1, 1885, outstanding liabilities	378 80	
		6,729 37
July 1, 1885, amount available		8,863 43
Amount (estimated) required for completion of existing project		40,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		15,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

P 11.

IMPROVEMENT OF CHOCTAWHATCHIE RIVER, FLORIDA AND ALABAMA.

This river rises in Southeastern Alabama and flows in a southerly and southwesterly direction past the towns of Newton, Geneva, and Caryville (the crossing of the Pensacola and Atlantic Railroad), emptying into Choctawhatchie Bay, whence Santa Rosa Sound connects it with Pensacola Harbor. The river flows through a rich agricultural country, in a region which contributes, by means of this river and Santa Rosa Sound, a large proportion of the lumber transported from Pensacola. The States of Alabama and Florida have appropriated $40,000 heretofore for the improvement of the river from Geneva to its mouth. The present plan of improvement, made pursuant to an examination under authority of an act of Congress approved in 1871, and a subsequent examination under an act approved March 3, 1879, was adopted in 1872, and modified in 1880, and contemplates the improvement of the river from its mouth to Newton, a distance of 252 miles, so as to obtain a low-water navigable channel.

The expenditure of $62,509.58 has resulted in giving 4½ feet of water in the channel, except during low water as far as Jones's old ferry, 27 miles above Geneva, and 2 feet of water in the channel as far as Pate's Creek, at a medium stage of water. During high water 5 feet can be carried to this point.

During the past fiscal year the snag-boat has been kept at work between Geneva and Half Moon Bluff, removing logs and snags from the channel, and overhanging trees from the banks between these points, the principal navigation being now concentrated on this section. This boat has been equipped with a steam capstan.

It is proposed to apply the funds remaining on hand and the appropriation asked for to the further improvement of this river and the maintenance of the work already done pursuant to the approved plan.

The navigation of this river is obstructed by a wagon bridge near Geneva, Ala., about 20 feet above low water, and so constructed that it cannot be modified. It should be taken down. The navigation of the river is also obstructed by a similar bridge 7 miles below Newton, which must also be removed if the improvement of the river is carried to that point.

The funds on hand will have been exhausted before the close of the present working season. The appropriation asked for will barely suffice to pay the running expenses of the snag-boat, and maintain one party at rock excavation and other work of improvement.

If a less amount than that asked for be appropriated, the working plant will suffer the consequences of deterioration from disuse.

COMMERCIAL STATISTICS.

It is estimated that the improvement of this river has already resulted, through competition, in reducing freights from 25 to 50 per cent. Statistics for the past fiscal year have not been received, but in the year ending June 30, 1884, twenty-five steamers and sailing vessels, aggregating 873 tons capacity, were employed in the navigation of the river, the freights carried being cotton, wool, lumber, timber, turpentine, rosin, &c.

Money statement.

July 1, 1884, amount available		*$772 27
Amount appropriated by act approved July 5, 1884		15,000 00
		15,772 27
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$5,677 82	
July 1, 1885, outstanding liabilities	604 03	
		6,281 85
July 1, 1885, amount available		9,490 42
Amount (estimated) required for completion of existing project		50,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		15,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

P 12.

IMPROVEMENT OF LA GRANGE BAYOU FROM ITS MOUTH TO THE TOWN OF FREEPORT, FLORIDA.

The La Grange Bayou extends about 2 miles in a northeasterly direction from the north side and near the head of Choctawhatchie Bay, and into it flows Cedar Creek, a deep stream from 90 to 160 feet wide, on which is situated the town of Freeport, 1½ miles above the bayou.

The plan of improvement adopted was made pursuant to an examination of this bayou in 1881, under an act of Congress approved March 3, 1881, and contemplates the deepening of the channel through the bayou so as to admit the passage of vessels drawing 4½ feet at mean low water, the work to be done by dredging.

Up to the 30th of June, 1885, there has been expended on this work the sum of $2,000, allotted from the appropriation of $20,000 made by an act approved August 2, 1882, for the improvement of the Choctawhatchie River, Florida, the two improvements being closely related. The result has been to secure a channel 5 feet in depth at mean low water.

During the past fiscal year the small balance available ($772.27) has been expended in the work of dredging and removing the logs, slabs, &c., from the channel.

It is proposed to expend the appropriation asked for in widening this channel and in removing the remaining obstructions.

COMMERCIAL STATISTICS.

Information as to the commerce of this bayou during the past fiscal year has not been obtained, but it appears that in the year ending June 30, 1884, thirty-two steamers and sailing vessels, aggregating 1,036 tons capacity, were employed in the navigation of the bayou, carrying freights of cotton, wool, lumber, merchandise, &c., and that no increase in the number of vessels has taken place since the work of improvement.

Money statement.

July 1, 1884, amount available	$772 27
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	772 27
Amount (estimated) required for completion of existing project	5,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	5,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

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*To La Grange Bayou, Florida (allotment).

P 13.

IMPROVEMENT OF PENSACOLA HARBOR, FLORIDA.

Pensacola Harbor, on the coast of Florida, is a deep-water harbor, on the Gulf of Mexico, within which is an extensive naval establishment of the United States, and from which, during the last fiscal year, there cleared 480 steamships and sailing vessels, aggregating 280,354 tons.

The improvement of this harbor was commenced in 1878, by the removal of certain wrecks forming obstructions to navigation. In 1879 a survey was made for the purpose of ascertaining the extent and probable cause of the shoaling of the main ship-channel at a point known as the "Inner Bar," and pursuant to this survey, which was referred to the Board of Engineers on Fortifications and Harbor Improvements, a plan of improvement was adopted which contemplates the temporary relief of navigation by dredging a channel across the inner bar, and the preservation of the shore line at the site of Fort McRee by the construction of jetties and shore protections for the purpose of projecting the site for defensive works and preventing further changes in the tidal currents, both ebb and flood; the channel to be dredged to a depth of 24 feet, with a width of not less than 300 feet. The contract for the work of dredging was made July 28, 1881, but this contract was annulled, no work having been done under it, and much delay ensued in the effort to get the work done under contract.

Proposals were invited for the construction of the proposed jetties and shore protections, but the bids were considered excessive and the work was done by hired labor and the purchase of material in open market. The expenditure up to the present time of $172,581.97 has resulted, as to the channel, in obtaining a depth of 24 feet at mean low water over the inner bar, with a width of 120 feet. This increased width and depth were not maintained by the tides, and the channel has required redredging. On June 30, 1885, a depth of 21.8 feet existed. The work of shore protection has resulted in arresting the process of abrasion and advancing the shore line about 250 feet, while the 12, 18, and 24 foot curves of the western channel, fronting this shore line, have also advanced. North of the work at Fort McRee the shore line has not materially changed, the point being held by the works. To the west of this point, towards the mainland, the shifting sand-banks which mark the entrance to the lagoon have moved southward, and are, to a great extent, covered by the débris of the fort, which has been washed around. This work may be regarded as permanent when the jetties are protected by suitable coping and slope protection. It would probably require after that only very slight annual repairs. The channel must be dredged continuously during favorable weather, at an estimated cost of $50,000 annually.

Should a plan of permanent improvement be adopted for this harbor the deepening of the channel across the inner bar may be effected by the same works which provide for increasing the depth on the outer bar. It is suggested that converging jetties upon Calafatas Shoal and East Bank, respectively, will accomplish this, and possibly a single jetty on Calafatas Shoal. It has not been practicable, with the funds available, to make a sufficiently detailed examination for a detailed project, but

the work would obviously require the expenditure of a large sum of money. In the absence of such a permanent improvement the annual expenditure of $50,000, or whatever sum approximating this may be found necessary for maintaining across the inner bar whatever depth can be carried across the outer bar, is recommended. The depth which could be carried across the outer bar at the date of last survey at mean low water was 21.8 feet.

During the past fiscal year the close piling of the shore protection was replaced, and the mattress filling raised above high water. This work was extended 217½ feet, the trestle and tramway approach rebuilt, a spur 20 feet wide and 80 feet in length constructed on the south side of it, and the entire exposed face of work revetted with brush-mattresses and rock ballast. The outer end of Jetty A for a length of 105 feet on the south side and 126 feet on the north side was revetted in like manner. Jetty A, the wharf, and appliances were maintained and repaired, and an office building erected near the site of the works.

The continuation of the work of dredging, under the contract with Seth N. Kimball, resulted in the removal of 16,387.75 cubic yards of material, widening the dredged channel across the inner bar to 120 feet, and increasing the depth to a minimum of 24 feet at mean low water, completing his contract August 9, 1884.

Under the appropriation made available July 5, 1884, a contract was made for the continuation of the work of dredging, but no work was performed by the contractor and his contract was annulled.

Under a contract with Mr. G. W. Adams for the hire of the suction-dredge Bayley for three months at a cost of $333.33 per day, dredging of the channel across the inner bar was recommenced May 25, 1885.

During the suspension of the work of dredging from August 9, 1884, to May 25, 1885, and probably to some extent during the prosecution of the work, the channel opened under contract with Kimball was partially refilled, reducing its depth on the center line to a minimum of 20.4 feet at mean low water.

The quantity of material removed by the dredge Bayley during the fiscal year ending June 30, 1885, was 36,982.5 cubic yards, increasing the minimum depth on the center line from 20.4 to 21.8 feet at mean low water.

During the period from May 25, 1885, to June 30, 1885, the dredge worked 302 hours, reckoning from the time of leaving wharf to time of returning to same, which gives an average of 122.46 cubic yards per hour of actual working time, at a cost of 34¼ cents per cubic yard. The cost under the former contract, in which work was paid for by the cubic yard, was 79.7 cents per cubic yard, and the price under the last contract, which was annulled, was 74.74 cents per cubic yard.

It is proposed to apply the funds remaining on hand and the appropriation asked for to the completion of the works of shore protection at the site of Fort McRee and the continuance of the work of dredging the inner bar for the relief of navigation.

This work has been in charge of Assistant Engineer Hiram Haines.

The funds on hand will be exhausted before the close of the present working season. The amount asked for is the least that will suffice for securing the jetties and shore protection against destruction from the violent storms to which they are exposed, and for dredging the inner bar. The completion of the existing project leaves a necessity for continuous dredging, at an annual cost of $50,000.

Money statement.

July 1, 1884, amount available		$29,817 90
Amount appropriated by act approved July 5, 1884		55,000 00
		84,817 90
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$53,017 61	
July 1, 1885, outstanding liabilities	9,382 26	
		62,399 87
July 1, 1885, amount available		22,418 03
Amount (estimated) required for completion of existing project		60,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		60,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

The export trade of this harbor is principally carried in vessels of large capacity and consequently deep draught, the principal article of export being a bulky material, lumber and timber.

The capacity of these vessels sometimes exceeds 1,800 tons; for this reason a considerable depth of water over the bar is desirable.

During the past fiscal year there were entered at the port of Pensacola 457 vessels, whose aggregate tonnage was 272,943 tons. There were cleared 480 vessels, whose aggregate tonnage was 280,354 tons. In the traffic of Pensacola Harbor 108 steamers and sailing vessels were employed.

There were exported 13,501 bales of cotton and 100,464,364 feet B. M. of lumber and timber.

Value of imports and exports.

Direction.	For fiscal year ending June 30, 1885.	For fiscal year ending June 30, 1884.
Value of exports to foreign ports	$1,967,275 00	$2,580,688 00
Value of exports to coastwise ports	806,635 00	444,558 00
Total value of exports	2,773,910 00	3,025,246 00
Value of imports from foreign ports	9,912 00	44,101 45
Value of imports from coastwise ports	536,682 00	(*)
Total value of imports	546,594 00	44,101 45
Total value of exports and imports	3,320,504 00	3,069,347 45

*No record.

Custom-house receipts.

Description.	June 30, 1885.	June 30, 1884.
Duties on imports	$9,911 95	$9,053 65
Tonnage tax	8,346 15	50,355 90
Marine-hospital tax	538 62	2,111 05
Fines, penalties, and forfeitures	202 78	686 72
Inspection of steam-vessels	110 00	375 00
Immigrant fund	19 50	13 00
Official fees	2,746 80	3,642 50
Miscellaneous	959 99	511 55
Total	22,835 79	66,749 37

The falling off in the exports since last year, and the consequent diminution of the custom-house receipts, is due to the diminished export of lumber.

The supply of lumber which can be shipped from this port is equal to any probable demand.

P 14.

PRELIMINARY EXAMINATION OF OUTER AND INNER BARS AT THE ENTRANCE OF PENSACOLA HARBOR, FLORIDA.

UNITED STATES ENGINEER OFFICE,
Montgomery, Ala., October 22, 1884.

SIR: In compliance with letter of September 4, 1884, from office of the Chief of Engineers, I have caused a preliminary examination to be made of the inner and outer bars of Pensacola Harbor, Florida, with a view to ascertaining whether the harbor is worthy of improvement, and the probable cost of making a further survey and report, comtemplated by the river and harbor act of July 5, 1884, and including the project and estimates of cost of improvements proper to be made.

This examination has been made, under my direction, by Assistant Engineer Hiram Haines, in local charge of the improvement of Pensacola Harbor.

His report, which is transmitted herewith, gives fully and specifically the information required.

In my opinion the harbor is worthy of improvement, because of the commercial importance of the port of Pensacola, and the great benefit to commerce which will result from the deepening of the channel across the inner and outer bars.

The cost of the necessary survey is estimated at $1,000.

For detailed information as to the commerce of this port and its relative importance, attention is invited to the commercial statistics and statement of facts furnished in the accompanying report of assistant engineer.

Very respectfully, your obedient servant,
R. L. HOXIE,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

REPORT OF MR. HIRAM HAINES, ASSISTANT ENGINEER.

PENSACOLA, FLA., *October* 20, 1884.

SIR: In accordance with the instructions contained in your letter of the 15th instant, I have the honor to report that in pursuance of instructions from Maj. A. N. Damrell, Corps of Engineers, United States Army, a preliminary examination was made of the Outer Bar at the entrance of Pensacola Harbor in July last. A general survey of the entrance to this harbor was made by me in 1879, embracing a detailed survey of the Inner Bar and channel curves, upon which was based a project for its improvement by dredging a channel 300 feet wide across the Inner Bar for the immediate relief of the commerce of the harbor, and the construction of a series of jetties contiguous to the site of Fort McRee, for the preservation of the shore line at that point (which was undergoing rapid abrasion), as a strategic position for the defense of the harbor, and for the purpose of producing such a regimen of the tidal currents as would tend to maintain the dredged channel.

The prosecution of this work under appropriations subsequently made has resulted in the completion of jetty works, which have arrested the abrasion of the shore-line at Fort McRee, and in the excavation of a channel, by dredging, 120 feet wide, across the Inner Bar to a depth of 24 feet at mean low water.

An extension of the jetty works is now in progress of construction for the purpose of more effectually protecting the shore-line at Fort McRee, for the completion of which a sufficient amount is now available, and a contract has been made for the continuation of the work of dredging the proposed channel across the Inner Bar under the appropriation made available July 5, 1884.

Examination of the Inner Bar since the suspension of the work of dredging, under a previous contract, in August, 1884, shows that in addition to the alteration effected

by the excavation of the channel across it, a change of its contour has also resulted from a displacement and redeposit of material disturbed in the operation of dredging. The suspension of this work is also attended with a change of form of the excavated channel, occasioned by its side slopes assuming prematurely the angle of permanent repose, tending to refill it partially, and involving work for its removal not provided for in the original estimates of the cost of this branch of the project, increasing in its amount as the period of its suspension extends. The increase due to these changes of the form of the bar and channel, and necessary to be removed to complete the work as proposed, it is approximately estimated will be equivalent to 25 per cent. of the quantity originally estimated, or about 20,000 cubic yards, and will cost $20,000 for its removal.

The preliminary examination of the Outer Bar reported to Maj. A. N. Damrell, Corps of Engineers, U. S. A., July 15, 1884, shows the distance across it between the 25 feet curves to be 3,000 feet, the minimum depth upon the crest of the bar to be 22. 25 feet at mean low water, and the amount of excavation required to cut a channel across it 300 feet wide, affording a depth of 24 feet at mean low water, or the same depth as is contemplated for the channel across the Inner Bar is estimated to be 80,000 cubic yards. This work is more exposed than that on the Inner Bar, and will cost about $100,000 for its execution.

* * * * * *

It is estimated that the cost of a further and detailed survey of the Outer Bar, and estimate of the cost of its improvement contemplated by the river and harbor act July 5, 1884, will be $1,000.

The commercial statistics of the port of Pensacola for the fiscal year ending June 30, 1884, exhibits the present extent and importance of its foreign and domestic commerce. It will be observed that the tonnage of sailing-vessels entering this port exceeds that of any port on the Atlantic and Gulf coast between Philadelphia and the Rio Grande, including Baltimore and New Orleans.

It is the only deep-water port on the Gulf coast. Vessels drawing over 20 feet can load alongside the wharves of the city, and a spacious anchorage is afforded for vessels drawing 26 feet in close proximity to the city and naval station.

The number of vessels that cleared from Pensacola with a partial cargo, owing to an insufficient depth of water on the Inner Bar, from July 1, 1883, to May 19, 1884, was twenty-eight, aggregating 32,227 tons. When leaving port all of these vessels drew less than 21 feet, and were detained several days.

In addition to the above, there were twenty-five vessels with full cargoes, aggregating 25,388 tons, and drawing less than 21 feet of water, which were detained, for want of sufficient water on the bar, from two to ten days. The number of vessels drawing 21 feet and upwards which had sailed since the first cut was made across the Inner Bar to June 30, 1884, was six, aggregating 7,085 tons. No vessels have been detained since the first cut was made, and the largest cargoes of lumber and timber ever shipped by steamer or sailing-vessel from any southern port have sailed from Pensacola since the 1st of July, 1884.

These facts are the best evidence of the practical benefit to the commerce and navigation of the harbor which has thus far resulted from the improvement in progress.

As the site of one of the largest and best appointed naval stations of the country, Pensacola Harbor possesses consequence as an important position for naval operations in the Gulf of Mexico.

Its geographical position relatively to the commerce of the Gulf, its proximity to resources which form the material of war as well as of commerce, to the development of which so wonderful a momentum is now being imparted, the removal of a great barrier to the commerce of Europe and America with the Pacific by the construction of the Isthmus Canal, the rapid extension of the net-work of railways in the Gulf States, of which Pensacola is an important terminus, developing the capacity of production of agricultural values, mining and manufacturing resources of these States, will at no remote period give test to the capacities and advantages of every Gulf port which will give prominent significance to this harbor. Of the prospective commerce of the Gulf and its relation to the future of this country Lieutenant Maury says:

"On this continent nature has been prodigal of her bounties. Here upon this central sea she has with lavish hand grouped and arranged in juxtaposition all those physical circumstances which make nations truly great. Here she has laid the foundation for a commerce the most magnificent the world ever saw. Here she has brought within the distance of a few days the mouths of her two greatest rivers. Here she has placed in close proximity the natural outlets of her grandest river basins. With unheard-of powers of production these valleys range through all the producing latitudes of the earth. They embrace every agricultural climate under the sun; they are capable of all variety of productions which the world besides can afford. On their green bosom rests the throne of the vegetable kingdom. Here commerce, too, in time to come will hold its court.

"The three great outlets of commerce, the delta of the Mississippi, the mouths of the

Hudson and Amazon, are all within 2,000 miles, ten days' sail to Darien. It is a barrier that separates us from the markets of 600,000,000 of people, three-fourths of the population of the earth. Break it down therefore and this country is placed midway between Europe and Asia, this sea becomes the center of the world and the focus of the world's commerce. This is a highway that will give vent to commerce, scope to energy, and range to enterprise; which in a few years will make gay with steam and canvass parts of the ocean that are now unfrequented and almost unknown. Old channels of trade will be broken up and new ones opened."

In compliance with your request that I would state whether, in my opinion, the harbor is worthy of improvement, and to give fully and particularly the facts and reasons upon which I base such an opinion, I would respectfully state that I am of the opinion that it is worthy of improvement, and submit the foregoing facts and impressions in support of this opinion.

Very respectfully, your obedient servant,

H. HAINES,
Assistant Engineer.

Capt. R. L. HOXIE,
Corps of Engineers, U. S. A.

Number and character of vessels entering and clearing at the port of Pensacola, Fla.

FISCAL YEAR 1883.

Vessels.	Number.	Tonnage.	Foreign cargoes.		Coastwise cargoes.		Foreign in ballast.		Coastwise in ballast.	
			In.	Out.	In.	Out.	In.	Out.	In.	Out.
Steamers	11	5,226	.....	2	.....	.....	1	.....	5	3
Ships	53	54,725	5	23	1	.....	22	.....	2	.....
Barks	663	420,114	29	320	5	16	270	.....	20	3
Brigs	104	40,115	3	37	2	16	29	.....	17	.....
Schooners	280	91,984	7	42	25	100	28	.....	75	3
Total	1,111	612,164	44	424	33	132	350	.....	119	9

FISCAL YEAR 1884.

Steamers	27	30,954	1	11	.....	.....	5	1	9	.....
Ships	62	69,494	4	33	.....	.....	19	.....	6	.....
Barks	721	465,100	45	352	4	9	287	.....	24	.....
Schooners	307	107,304	11	53	33	94	29	1	81	5
Brigs	67	25,999	4	24	2	6	18	.....	11	2
Total	1,184	698,851	65	473	39	109	358	2	131	7

SURVEY OF OUTER AND INNER BARS AT THE ENTRANCE OF PENSACOLA HARBOR, FLORIDA.

UNITED STATES ENGINEER OFFICE,
Montgomery, Ala., January 30, 1885.

SIR: In compliance with letter from the office of Chief of Engineers, dated November 21, 1884, I have the honor to submit the following report upon the survey of the outer and inner bars at the entrance of Pensacola Harbor, Florida (see section 9, river and harbor act, July 5, 1884).

INNER BAR.

In November, 1876, by direction of the Chief of Engineers, the first examination of this harbor was made, with a view to the removal of certain wrecks therein which were thought to be the cause, to some extent, of the shoaling of the main channel inside the bar to 21 feet at low water. Examination was made by Maj. A. N. Damrell, and under

his direction an appropriation of $20,000 was expended in the removal of these wrecks. The removal of the wrecks was commenced during the fall of 1878, and completed in December, 1879. In that year a survey of the entrance to the harbor, for the purpose of ascertaining the extent and probable cause of the shoaling of the main channel south of the Middle Grounds, was made under the direction of Major Damrell, and a project submitted by him, which was referred to the Board of Engineers for Fortifications and for River and Harbor Improvements. This Board reported, under date of February 12, 1881, substantially approving Major Damrell's project, and recommending in detail the work which has since been done.

The Board say:

The entrance way to Pensacola Bay, Florida, lying between the west end of Santa Rosa Island and the main shore opposite, is about a mile in width. Middle Ground shoal divides its channel, pressing the deeper water towards Fort McRee, while the swash channel flows in close proximity to the island. The bar, 1¾ miles outside of the forts, connects with the south shore of Santa Rosa Island, through East Bank, and with the west beach through Caucus Shoal. At low water, so far as our records go, it has always admitted vessels of 22 feet draught.

Until recently a greater depth was obtained in the channel inside of the bar. But at this time the Middle Ground has stretched southerly to unite with the east end of Caucus Shoal by a sand deposit, reducing the channel depth from 4 fathoms to 21 feet, with a tendency to further obstruction if the cause be not arrested.

To comprehend more fully this channel disturbance, it will be necessary to refer to its past progress, so far as the maps in our possession furnish information in reference thereto. Now we know that as early as 1855 the main shore had been so much abraded as to expose the foundations of the *pan coupe* of Fort McRee. The Coast Survey chart of soundings of 1856 shows a deposit between the Middle Ground and Caucus Shoal, with least depth of 19 feet upon it, and leaving but a narrow channel on either side, giving 24 feet water. Between the years 1855–'60 the work of restoring the McRee shore was prosecuted by means of short jetties, which proved effectual in reforming the beach to a certain extent. As these jetties, however, did not extend down to the bottom of the channel, they were gradually undermined, and finally disappeared from view. We have no soundings to show their effect upon the channel, but doubt if their length was sufficient to restore its normal condition. At any rate the Coast Survey chart of 1864 shows the same deposit in the channel-way as above noticed, marked by a buoy with an indicated depth of 19½ feet, but apparently connected with the Middle Ground. Since that date the western shore has been receding with a constant progress until the low-water line has reached the gateway at the rear of Fort McRee, the masonry of which has nearly all fallen down by being undermined. The 24-foot channel curve has moved west and south from 400 to 500 feet on the channel side of Caucus Shoal. But this change has not been carried to the east end of the shoal, as both the 24 and 21 foot bottom curves sweep around to the north and join the Middle Ground. It would seem that the outflowing water reaching this deep bend has not sufficient eroding power to cut through the compact formation of the shoal, except by a slow abrasion, and that the living force of the portion turned eastward is too far checked to remove the deposit which now obstructs the channel.

* * * * * * *

If the west shore can be fixed, remedial measures may be instituted to recover the former depth of water in the channel, though it seems probable that the progress of the erosion already made in a westerly direction will somewhat change its lines in approaching and crossing the bar.

* * * * * * *

In conclusion, the Board are of opinion that the west shore of the entrance to Pensacola Bay should be protected from further abrasion for the following reasons:

(1) The preservation of a site for batteries needed for defensive purposes. This is a matter the more important that Pensacola has a navy-yard to be protected in addition to its valuable commercial interests, and that it is a good harbor of refuge on the Gulf.

(2) To arrest the movement westward and southward of the channel, which by turning too abruptly the ebbing current as it approaches the Caucus Shoal checks its flow and leads to the formation of a deposit from Middle Ground across the channel.

The Board further recommends that a cut be made by dredging through the recent deposit at the entrance of the harbor approximately on a line, DD, with the suggestion, however, that the local engineer should determine its position more accurately by a succession of current observations in the immediate vicinity.

In accordance with these recommendations, work has been continued to the present time and the abrasion of the west shore has been successfully arrested. The dredging of the channel across the inner bar has not yet been completed.

In his annual report for 1884 Major Damrell says:

> The condition of the improvement on the June 30, 1884, is as follows:
>
> A channel 80 feet in width has been dredged across the "Inner Bar," having a minimum depth at mean low water of 22½ feet, and affording a passage at mean high water for vessels drawing 24 feet and less, at the maximum draught that can at any time be carried across the outer bar.
>
> The draught of vessels leaving the harbor having heretofore been restricted to 20½ feet as a maximum, owing to the obstruction presented by the Inner Bar, and the character of vessels entering this harbor consisting largely of a class exceeding that draught when fully loaded, much relief is afforded its commerce in thus rendering available a greater carrying capacity and facilitating the departure of vessels.
>
> The condition of the jetty works as completed is substantial, and they appear capable of resisting in their present state the shocks of any storm-waves to which they are likely to be subjected; but as their permanence depends chiefly upon their protection from the teredo and lateral scour, their condition is liable to be rapidly impaired unless such protection is afforded. The most positive protection would be the advance and maintenance of the beach around them, excluding the water from contact. Nearly the entire line upon the south side of the main jetty is already fully protected in this manner. The permancy of the work would, therefore, be best secured by their own efficiency in accomplishing this result.
>
> It is, however, very obvious that with the most favorable results in this respect that can be reasonably anticipated a part of this work will be exposed. For such exposed part a revetment of brush-mattresses riprapped with rock ballast will have to be made. The advance of the beach-line on the south side of Jetty A is now 250 feet.
>
> There has been an advance also of the 12, 18, and 24 foot curves of the western channel slope fronting the shore-line south of the jetty works, by which the configuration of the contour of this slope has been favorably altered.
>
> The shore-line north of this work contiguous to Fort McRee has not materially changed. The line of beach north of the entrance to the lagoon for three-quarters of a mile in the direction of the light-house has receded under the effect of storm-waves.
>
> * * * * * * *

As a result of the recent examination and survey it is found that the dredged channel has silted up to some extent, about 6,200 cubic yards having been deposited since the suspension of work of dredging, August 9, 1884, and about 8,000 cubic yards having entered the cut by the fall of the side slopes to a flatter inclination.

It is to be remarked that since the commencement of work on shore protection at Fort McRee the 24-foot channel curve has made little or no progress into the Caucus Shoal, although the Middle Ground Shoal has moved down directly toward the dredged cut about 100 feet, its 18-foot curve having advanced that distance. It is reasonable to suppose that the gradual advance of the west shore, affected by the extension of the shore protection, would eventually restore the original condition of things existing before the washing away of this shore, and enable the dredged channel to maintain itself. Should the erosion of Caucus Shoal and the southward movement of the Middle Ground continue, a new channel will be cut through Caucus Shoal and the old one will be obliterated. This would be a radical disturbance of a heretofore conservative harbor entrance; would turn the direction of entrance toward comparatively shallow water in the Gulf, and would dislodge and move in this direction a great quantity of sand from the eroded channel. Serious complications must accompany the obliteration of the old with the formation of the new channel.

OUTER BAR.

Attention has not heretofore been directed to the Outer Bar, complaint having been made exclusively of the shoaling of the main chan-

nel inside the bar, which prevented the entrance of vessels that could pass the Outer Bar. The Coast Survey chart of 1857 (the soundings taken in 1856) shows a depth of $3\frac{3}{4}$ fathoms, or $22\frac{1}{2}$ feet, over the Outer Bar. The survey made in 1884, under Major Damrell's directions, shows 22 feet over this bar, and the recent examination and survey a scant 22 feet. During nearly thirty years this bar appears to have remained sensibly constant in position and with nearly the same depth over it. There is no reason whatever to suppose that a dredged channel across this bar would maintain itself. It would be necessary to maintain it by continual dredging or by expensive works of contraction. The excavation of a channel 24 feet in depth at mean low water and 300 feet wide across this bar by dredging will require the removal of 85,400 cubic yards of material. Dredging in this locality is hazardous and uncertain, and the amount of material to be removed annually to maintain such a cut cannot be estimated.

Works of contraction on Caucus Shoal and East Bank, to maintain this depth on the Outer Bar by directing a greater volume of the ebb flow across it, should not be undertaken before the difficulty inside the bar shall have been overcome. It may be necessary for the latter purpose to diminish the flow over Caucus Shoal and deflect the ebb currents into their former channel.

RECOMMENDATIONS.

It is recommended that the work of dredging the channel across the Inner Bar be completed and the shore-line at Fort McRee be gradually advanced as heretofore, noting the effect upon the channel curves, and being governed by this in the extension of the work. Should other work be found necessary to re-establish the original direction of the tidal current, a separate estimate can then be presented.

To complete the dredging of the channel across the Inner Bar with side slopes of 1 upon 20 will require the removal of 76,700 cubic yards, of which 53,500 cubic yards are provided for under existing contract, leaving 23,200 cubic yards, for which an appropriation is required. It is not probable that these slopes, in shifting sand, which are steeper than the natural slopes of surrounding shoals, will be permanent, but they may serve the purpose intended for the present.

ESTIMATES.

For completing the dredging across the Inner Bar, 23,200 cubic yards, at $1 per cubic yard	$23,200
For continuing the work of shore protection of Fort McRee	20,000
Engineering and superintendence	5,000
Total	48,200

The work is situated in the collection district of Pensacola, Fla., which is the port of entry, and near Pensacola light-house and Forts Pickens and Barrancas.

COMMERCIAL STATISTICS.

In the language of my predecessor, Major Damrell:

The harbor of Pensacola, Fla., is undoubtedly the finest harbor on the Gulf of Mexico. It covers an area of over 20 square miles, with ample depth and good anchorage ground; is perfectly landlocked and easy of access. Pensacola is the port of entry. The commerce of this port consists almost exclusively in the exportation of timber and lumber, principally to foreign countries, and is mostly carried on in vessels of heavy draught.

* * * * * * *

In this harbor is also located a United States navy-yard, the only one on the Gulf of Mexico, and this fact alone would make the preservation of a deep channel through its entrance a work of national importance.

* * * * * * *

The preliminary report of Mr. H. Haines, assistant engineer in charge of this improvement, gives in detail the commercial statistics of this harbor. It will be observed, he says:

That the tonnage of sailing vessels entering this port exceeds that of any port of the Atlantic and Gulf coasts, between Philadelphia and the Rio Grande, including Baltimore and New Orleans. It is the only deep-water port on the Gulf coast; vessels drawing over 20 feet can load alongside the wharves of the city, and a spacious anchorage is afforded for vessels drawing 26 feet, in close proximity to the city and naval station.

Value of imports, 1884		$44,101 45
Value of exports, 1884		3,035,246 08
Tonnage of vessels entering, 1884	tons	348,640
Tonnage of vessels cleared, 1884	do	350,203
Custom-house receipts, 1884		66,749 37

I transmit herewith the report of Mr. Hiram Haines, assistant engineer, and three tracings* of surveys.

Very respectfully, your obedient servant,

R. L. HOXIE,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.
(Through Lieut. Col. D. C. Houston, Corps of Engineers, U. S. A., Supervising Engineer.)

[First indorsement.]

JACKSONVILLE, FLA., *February* 3, 1885.

Respectfully forwarded to the Chief of Engineers.

This report does not propose any change in the existing project for the improvement of Pensacola Harbor, which has reference only to the Inner Bar, and the preservation of the west shore at the harbor entrance. No project is submitted for the improvement of the Outer Bar

D. C. HOUSTON,
Lieut. Col. Engineers,
Bvt. Col., U. S. A.

REPORT OF MR. HIRAM HAINES, ASSISTANT ENGINEER.

PENSACOLA HARBOR IMPROVEMENT,
January 17, 1885.

SIR: In pursuance of the instructions contained in your letter of the 17th ultimo, I have the honor to report that I have made a survey of the inner and outer bars at the entrance of Pensacola Harbor, Florida, from which has been projected the inclosed map and profiles and the subjoined estimates deduced.

Soundings were taken upon the center and exterior lines of the proposed channel across the Inner Bar, of which profiles are given, and upon lines corresponding with the centers of the three cuts made across the bar, shown by dotted lines in the contour map, and transversely throughout its length. Several lines were sounded across the Inner Bar; that corresponding with the line of the present ship-channel appearing the most desirable was selected as a basis for estimation of costs, and of which a profile is given. Sextant observations were taken at frequent intervals upon each line of soundings to determine the position of changes of depth, and all soundings were reduced to mean low water.

The completion of the proposed channel across the Inner Bar 300 feet wide to 24 feet depth at mean low water, with slopes 20 to 1, will require the removal of 76,700 cubic

* Omitted.

yards of material. Of this amount 6,200 cubic yards have been deposited in the dredged channel since the suspension of the work of dredging August 9, 1884, about 10,000 cubic yards deposited during the operation of dredging upon reverse sides of the proposed channel at each end by the tidal currents which were diagonally across it, and about 8,000 cubic yards accruing from a reduction of the angle of the slopes from 12 to 1 upon which the estimate of 1881 was based to 20 to 1, which observation shows to be advisable in computing the excavation required. It is probable that this angle will have to be still further reduced to attain slopes of permanent repose. The deposit in the dredged channel is derived from the adjacent material dislodged by the contact or motion of passing vessels and by the sloping of its sides under the action of storm waves.

The amount allotted for this work of the appropriation made available for improving Pensacola Harbor July 6, 1884, was $40,000, which, at 75 cents (?) per cubic yard, the price at which the contract for the continuation of the work of dredging was made, will remove about 53,500 cubic yards, leaving 23,200 cubic yards to be provided for.

The excavation of a channel across the Outer Bar, 300 feet wide to a depth of 24 feet at mean low water, with an allowance of 1 foot for back filling, will require the removal of 85,400 cubic yards of material.

It is estimated that the cost of completing the excavation of the channel across the Inner Bar and the excavation of a channel, as specified, across the Outer Bar, will be as follows:

23,200 cubic yards of dredging on Inner Bar, at $1 per cubic yard	$23,200
85,400 cubic yards of dredging on Outer Bar, at $1.25	106,750

Statistics and facts relating to the present and prospective commerce of Pensacola, Fla., are embodied in my report of October 20, 1884, upon the preliminary survey of the Inner and Outer bars.

Very respectfully, your obedient servant,

H. HAINES,
Assistant Engineer.

Capt. R. L. HOXIE,
Corps of Engineers, U. S. A.

P 15.

PRELIMINARY EXAMINATION OF CLEAR WATER HARBOR, FLORIDA.

UNITED STATES ENGINEER OFFICE,
Montgomery, Ala., October 30, 1884.

SIR: In compliance with letter from the Chief of Engineers, dated September 4, 1884, I have caused a preliminary examination to be made of Clear Water Harbor, Florida, as provided for in section 9 of the river and harbor act of July 5, 1884, for the purpose of ascertaining whether the harbor is worthy of improvement, and, if such be the case, the cost of making the further survey and report contemplated by the act, including the project and estimate of cost of improvements proper to be made.

Owing to the fact that no record has been kept hitherto of the commerce of this harbor, it is not practicable to give accurate information respecting the present and prospective commerce, but from facts ascertained from other sources I am of the opinion that this harbor is worthy of improvement, provided a further detailed survey and examination shall show that such improvement can be made at a cost fairly proportioned to the benefit to be derived therefrom.

The cost of such survey is estimated at $1,500, including a reconnaissance of the entrances through Anclote and Saint Joseph's bays and the Narrows into Boca Ciega Bay.

This examination has been made under my direction by Assistant Engineer Hiram Haines. The report of Mr. Haines is transmitted herewith, and gives such facts as he has been able to collect respecting the re-

sources of the country to be benefited by the projected improvement, and the present and prospctive demands of commerce.

For detailed information attention is invited to this report.

A sketch showing general features of the harbor is transmitted herewith.

Very respectfully, your obedient servant,

R. L. HOXIE,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

REPORT OF MR. HIRAM HAINES, ASSISTANT ENGINEER.

TAMPA, FLA., *October* 25, 1884.

SIR: In compliance with the instructions contained in your letter of the 15th instant, I have made a preliminary investigation of facts respecting Clear Water Harbor, Florida, and have the honor to report that I find it to be worthy of a detailed survey, with a view to its improvement.

This harbor is situated on the west coast of Florida, about 20 miles north of the entrance to Tampa Bay. It is from 1 to 2½ miles wide, having three principal entrances, affording from 5 to 8 feet depth of water at mean low tide—the largest opening into Saint Joseph's Bay, the next in importance between Hog Island and Clear Water Key, and the other between Clear Water Key and Sand Key.

There are also five or six smaller islands situated inside of the sound between the lower entrances, and a shallow channel connecting the lower part of the harbor by a narrow passage with Boca Ciega Bay. The commerce of the harbor, which is rapidly increasing in magnitude, consists chiefly in sea-island cotton, fruits, vegetables, and cattle, and is carried on with one or two steamers and numerous sailing vessels of light draught, plying between it and Cedar Keys, Tampa, Key West, and other coast ports.

It also serves as a harbor of refuge for fishing-smacks and other craft engaged in coast traffic from various ports on the line of the Gulf coast from Mobile to Key West.

There having heretofore been no record kept of the commerce of this harbor, no definite or detailed commercial statistics relating to it can be gathered. The population of Hillsborough County, in which it is situated, is about 8,000, the distribution of which is comparatively thick on that part of the coast stretching from Anclote to the town of Clear Water Harbor; and this region is fast becoming filled with immigrants from the Northern States, and the orange culture and trade assuming large proportions.

It is estimated that the cost of a detailed survey and estimate of the cost of improving Clear Water Harbor and its entrances from the Gulf will be $1,500, and should also embrace a reconnaissance of the entrances through Anclote and Saint Joseph bays and "The Narrows" into Boca Ciega Bay. I have in the course of preparation a map of this harbor, showing its general features, which will be submitted by the next mail.

Very respectfully, your obedient servant,

H. HAINES,
Assistant Engineer.

Capt. R. L. HOXIE,
Corps of Engineers, U. S. A.

SURVEY OF CLEAR WATER HARBOR, FLORIDA.

UNITED STATES ENGINEER OFFICE,
Montgomery, Ala., February 14, 1885.

SIR: I have the honor to submit the following report of a survey made pursuant to section 9 of the river and harbor act approved July 5, 1884, of Clear Water Harbor, Florida.

Clear Water Harbor is a shallow sound at the head of Saint Joseph's Bay, on the west coast of Florida, the town of Clear Water Harbor, at its upper extremity, being almost due west from Tampa. The harbor is formed by Clear Water and Sand keys, lying off the mainland at a distance of $1\frac{3}{4}$ miles, and communicates with the Gulf of Mexico through Saint Joseph's Bay and through two passes known as Big and Little Clear Water passes.

A considerable coasting trade has grown up on the west coast of Florida between Cedar Keys and Clear Water, and other villages between these points, through Saint Joseph's Bay and Clear Water Harbor or Sound. Channels are available giving between 5 and 6 feet depth of water at mean low tide except at the points indicated for improvement. During the prevalence of strong easterly winds this depth may be reduced to a little less than 4 feet throughout the whole of Clear Water Sound. It is not proposed to provide for such an emergency, but to improve the principal channel so as to give $5\frac{1}{2}$ feet of water at ordinary low tide. This will accommodate the largest of the vessels now engaged in the coasting trade at this point. The localities where the improvement of the channel is required are shown upon the accompanying map.*

The improvement will require the removal by dredging of—

24,070 cubic yards of sand and shell mud, the cost of which at 40 cents per yard will be	$9,628 00
Add 20 per cent. for engineering and contingencies	1,925 60
Total cost	11,553 60

I am of the opinion that the harbor is worthy of improvement at least to the extent of this expenditure. It has a rapidly-growing trade with Cedar Keys, in which numerous vessels are engaged. The largest of these is the steamer Governor Safford, of 260 tons burden, a new vessel built by the Gulf Steamboat Company for this trade. She makes two trips per week between Cedar Keys and Clear Water Village. Two schooners, one of $19\frac{3}{4}$ tons and the other of 14 tons, make weekly trips, and other vessels, varying in tonnage from 6 to 40 tons, make occasional trips.

The survey of this harbor was made by Assistant Engineer J. L. Meigs, whose report, containing detailed information, is transmitted herewith.

The statistical information in the following table was furnished by merchants and citizens of the coast villages interested in this improvement:

Towns.	Population.	Number of people buying supplies and shipping products in the district.	Value of goods, groceries, fertilizers, and lumber sold annually.	Expected increase in the sale of goods, &c., and in agricultural products, during next five years, based on business of past five.	Advance in price of land in surrounding district over prices prevalent five years ago.
Clear Water	275	700	$30,000	Threefold	Fivefold.
Dunedin	207	207	50,000	do	do.
Yellow Bluff	500	500	20,000	Tenfold	Two and one-half fold.
Seaside	300		20,000		Twenty-fold.
Anclote	125	400	15,000	Fivefold	Two and one-half fold.

* Omitted.

Towns.	Articles.	Quantities.	Remarks.
Clear Water....	Boxes of oranges....	3, 500	Also large quantities of limes, lemons, and guavas.
	Crates of vegetables	8, 000	
	Number of fish.....	1, 000, 000	
Dunedin	Boxes and crates....	6, 000	
	Feet of lumber.....	600, 000	
Yellow Bluff...	Crates of oranges and vegetables.	6, 000	
Seaside.....	Crates	3, 200	
Anclote	Crates	2, 500	Cotton, hides, limes, fish, eggs, poultry, &c.
	Feet of lumber.....	200, 000	

Very respectfully, your obedient servant,

R. L. HOXIE,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.
(Through Lieut. Col. D. C. Houston, Corps of Engineers, U. S. A., Supervising Engineer.)

[First indorsement.]

OFFICE SUPERVISING ENGINEER,
New Orleans, La., February 28, 1885.

Respectfully forwarded, with inclosures, to the Chief of Engineers approved.

D. C. HOUSTON,
Lieut. Col. of Engineers,
Bvt. Col., U. S. A.

REPORT OF MR. J. L. MEIGS, ASSISTANT ENGINEER.

CLEAR WATER HARBOR, FLA., *January* 30, 1885.

CAPTAIN: The following report on the examination and survey of the navigable channel extending from the mouth of Anclote River to Little Clear Water Pass, on the west coast of Florida, and lying between the mainland and the islands bordering the coast, is respectfully submitted.

A careful reconnaissance of this part of the coast, made December 19 to 26, 1884, gave very full information in regard to the class of vessels navigating the channel, and the obstructions encountered by them, and afforded an opportunity to communicate with merchants and others in the coast villages with a view to obtain information about the trade and wants of the inhabitants. The schooner Eugene Batty was commissioned at Cedar Keys on December 31, 1884, and sailed to Clear Water Harbor, where the work of the survey was begun on the 2d of January following.

The Coast Survey chart of this coast, hitherto published, proved to be on too small a scale ($\frac{1}{1200000}$) to serve the purposes of a survey, and, no other satisfactory map being procurable, it was found necessary to make a rapid triangulation of the coast and islands, in order to show the portions of the villages and landing-piers along the coast and of the obstructed parts of the best navigable channels. Information in regard to the flow of the tides, the prevalence of winds causing the lowest tides, and the effects of storms on the depth of water on the bars obstructing the approaches to Little and Big Clear Water passes was obtained from masters of vessels and old residents of the coast. Continuous lines of soundings were made between the mouth of Anclote River and Little Clear Water Pass, and the shallow parts of the navigated channels definitely ascertained. Channel-stakes of yellow pine scantlings were then set up to mark the eastern and western boundaries of the obstructed channel. Base-lines, marked by iron terminal stakes, were run along the shore, and from their extremities angles were measured to ascertain the places of these stakes with reference to the base-lines. The channels were then sounded, the soundings reduced to low-water level, and the depths of the cutting required to give a channel 5½ feet deep at mean low water determined. The results of these operations are given below.

The work of the survey was delayed by stormy weather, which lasted for a week of the time occupied.

The channel required to be examined in your letter of instructions of December 17, 1884, traverses Saint Joseph's Bay and Clear Water Harbor, or, more properly, Clear

Water Sound. The coast lies for the most part within the limits of Hillsborough County, a very small part north of Anclote River being in Hernando County. The lands are elevated from 5 to 40 feet above the level of the Gulf of Mexico, and are equal in quality to the better kinds of pine lands in the State. They are probably more sought for by emigrants at the present time than the interior lands, owing to the better transportation afforded by the vessels navigating the coast channels and other advantages of a water front. There has been, therefore, recently, a considerable influx of new settlers and the value of lands has considerably increased.

The coast villages are Anclote, situated on the north bank of Anclote River at its mouth; Tarpon's Springs, a new and prosperous settlement on the south bank of the river, 1½ miles above its mouth; Seaside and Yellow Bluff, on Saint Joseph's Bay; and Dunedin and Clear Water, on Clear Water Harbor.

Piers of pile-work are built out from the shore to greater or less distances to accommodate vessels receiving and discharging freights at these villages. Off the mouth of Anclote River, 1¾ miles from the shore, a pile-work pier has been built in the middle of Saint Joseph's Bay, at which vessels receive freights brought from Anclote or Tarpon Springs by a small steam-launch. The depth of water at this pier, at mean low tide, is stated to be 10 feet. From this pier vessels entering the mouth of the river can ordinarily find 5 feet of water in the channel, except on an inconsiderable bar, distant about ¼ of a mile from a second pier built just within the mouth of the river. A considerable sum of money has been expended by Mr. Hamilton Diston, Governor A. P. K. Safford, and other capitalists in making these improvements. A pier for the common use of Seaside and Yellow Bluff has been built, but the depth of water at its head is not sufficient for the largest vessels plying in the trade between Cedar Keys and the coast, and freights are loaded by means of lighters. The pier at Dunedin hardly attains a sufficient depth of water. Dwight's Pier at Clear Water village is built to the edge of the deep channel, and the largest vessels can easily reach it at ordinary stages of the tide. The inhabitants along the coast have certainly shown great enterprise in providing facilities for their trade.

The trade of this region is almost exclusively with Cedar Keys, and numerous vessels are engaged in it. The largest of these is the steamer Governor Safford, 135 feet long, of 260 tons burden, and drawing when fully loaded 4 feet 2 inches. This is a new and superior vessel, and makes two trips per week between Cedar Keys and Clear Water Village. Two schooners, one of 19¾ tons and another of 14 tons, make weekly trips, and other vessels, varying in tonnage from 6 to 40 tons, make occasional trips. The recent considerable increase of the population and the large shipments now made of oranges and vegetables from the coast ports have created a necessity for better transportation of perishable products than sailing vessels afford, and the "Gulf Steamboat Company" has been incorporated and organized to supply the want. The first of their vessels, the Governor Safford, has very recently been put on the Cedar Keys and Clear Water line, which closely follows the line of channels authorized by you to be examined. Steam-vessels traversing this part of the coast must have sea-going qualities, that they may not be driven upon the coast shoals in time of severe storms, and it was deemed unsafe to build a vessel of less strength and steam-power than the Safford for this service. From 5 to 6 feet may be stated as the depth of water everywhere obtainable in the channels of Saint Joseph's Bay and Clear Water Harbor at mean low tide, except in the cases of the shoals or bars recommended in this report to be improved by dredging. The improvements proposed do not, therefore, require a greater depth of water at mean low tide than 5½ feet.

It should be stated that the prevalence of a strong north or northeast wind for a period of many hours will so greatly reduce the depth of water in Clear Water Harbor that not more than 3.9 feet can be given as the average depth in the channels at such times. The delays of navigation caused by extremely low tides of course are unavoidable.

Saint Joseph's Bay, lying between the mainland and Anclote and Hog Islands, varies in width from 3 to 3½ miles, and has wide communications with the Gulf of Mexico. The flow of tides is, therefore, comparatively uninterrupted, and the bay is but little obstructed by bars except at the mouths of Anclote River and Curlew Creek. The bed of the bay from north to south affords ample sea room, and has depths varying from 6 to 10 feet from the head of Anclote Islands southward to a point bearing 32½ degrees northwest from Dunedin Pier, and distant from it 1⅛ miles. Here vessels proceeding southward encounter a shoal about one-third of a mile in width, affording 5 feet of water at low tide, but which has never delayed the steamer Safford in any of her voyages, and does not, therefore, seem to require improvement at present.

This place may be regarded as the entrance into Clear Water Harbor, a sheet of water separated from the Gulf by Clear Water and Sand Keys, and connected with it by Big and Little Clear Water passes, the former about 1,000 feet and the latter 600 feet wide. The general width of Clear Water Harbor is 1¾ miles, and its bed, unlike that of Saint Joseph's Bay, is obstructed by many sand and mud bars. These project from the points of a number of small islands lying eastward of Big Pass and Clear

Water Key. Bars also extend southward down the harbor, masking the Little Pass, and terminating about three-quarters of a mile south of it. Between these bars, nevertheless, are channels easily navigated at mean low water by vessels drawing from 2 to 3 feet. At high tide vessels of 4½ feet draught can pass through them. The navigation for such vessels, however, is tedious and accompanied with expensive delays. One such channel, very tortuous, leads from Dunedin Pier to Big Pass, where its mouth is blocked by a gravel bar produced by the inflowing tides, and which, if dredged, would soon be refilled, even by a single storm from the west. Another channel affords everywhere a depth of 6 feet from Big Pass to Dwight's Pier. A third channel, trending southwestward from Dunedin Pier, enters the channel last named, and these two afford the most direct and easily improved route from Dunedin Pier to Dwight's Pier, at Clear Water Village. This may be called the "Dunedin Clear Water Channel," and it is respectfully recommended for improvement. When this is done, steamers of 4½ feet draught will meet with no delays in making their trips from Anclote to Clear Water at mean stages of the tide. The work to be done embraces about 16,820 cubic yards of sand and shell mud to be dredged, the channel to be 150 feet wide, and to be 5.5 feet deep at mean low tide. The dredging should commence at a point bearing south 30 degrees west from the head of Dunedin Pier, and distant 4,500 feet from it, and will extend for 2,668 feet, from section *Hh* to section *Rr* of the channel, shown on the accompanying map. The depths of the cutting will vary from 0 to 3.8 feet.

Vessels entering Clear Water Harbor from the Gulf rarely make use of Big Clear Water Pass, the approach to it being less favorable than that to the Little Pass, and the depth of water over the bar masking the Big Pass being less than in the case of the bar lying off the Little Pass. This affords 7½ feet of water at ordinary stages of the tide, while the depths in the pass itself vary from 14 to 27 feet. Within and near to this pass vessels bound for Dwight's Pier find the most favorable channel near and parallel to the east shore of Sand Key. At a distance of one-fourth mile from the pass the Sand Key is encountered. This requires to be dredged for a distance of 1,765 feet to depths varying from 0 to 2.8 feet, in order to provide a channel 5.5 feet deep at mean low tides, and 150 feet wide. The material to be excavated is sand and sand and mud mixed with shells, and will measure about 7,250 cubic yards. The steamer Safford experiences no difficulty in crossing this bar, but must await a favorable tide. She requires 5 feet of water at least, and the effort should certainly be made to improve all places (where improvements are attempted) so that the depths of the dredged channels shall be at least as great as the average depth of the harbor channels at mean low tide. This will afford vessels of the class of the Safford 5.5 feet of water, which is certainly not too much.

The estimated cost of the improvement recommended is as follows:

Improvement of Sand Key Bar		$2,900
Engineering and contingencies		350
		3,250
Improvement of Dunedin and Clear Water channels	$6,728	
Engineering and contingencies	807	
		7,535
Total		10,785

The cost of dredging is here taken at 40 cents per cubic yard.

The channels recommended for improvement are shown on the accompanying map, from which the positions of the channel-stakes set during the survey may hereafter be recovered, in case the work shall be put under contract.

* * * * * * *

STATEMENT OF NAMES OF VESSELS TOUCHING AT THE PORTS NAMED.

1. *Clear Water.*—Steamer Governor Safford, 260 tons, two trips weekly. Schooner Clara E. M., 19¾ tons, one trip weekly. Schooner A. C. Lowe, 14 tons, one trip weekly.

2. *Dunedin.*—Steamer Governor Safford. Steamer Eagle Pencil, tonnage unknown; occasionally. Schooner Falcon, 9½ tons, one trip weekly. Schooners Clara E. M.; A. C. Lowe; Lillie May, 6 tons; Maggie, 9 tons; Clyde, 10 tons; Golden Age, 10 tons; Jessie May, 6 tons. (All these make occasional trips.)

3. *Yellow Bluff.*—Schooner Sunrise, 10 tons, one trip weekly. Sloop Rosa, 5 tons; occasionally. Schooner Julia, 6 tons, twenty-five trips during 1884. Schooner Falcon, twenty trips during 1884. Schooner Clara E. M., occasionally.

4. *Seaside.*—Schooner Sunrise, one trip weekly.

5. *Anclote.*—Schooners Clara E. M., Falcon, Sunrise, Maggie, Eugene Batty, Blackhawk, Mayflower, Cecilia, Cootie, Sea Gull, Delia, and Julia, occasionally. Sloops

Jeannette, Tantalus, Breeze, Myra, Minnie, Hal. Rogers, Norman, Cape Fear, and Pompano, occasionally.

Acknowledgments are due to Messrs. W. E. Dortch and A. K. Meigs, of the surveying party, for their zealous labors, and to Messrs. C. B. Rogers & Co., of Cedar Keys, for valuable assistance rendered the party.

Very respectfully, your obedient servant,

J. L. MEIGS,
Assistant Engineer.

Capt. R. L. HOXIE,
Corps of Engineers, U. S. A.

P 16.

PRELIMINARY EXAMINATION OF UPPER OCONEE RIVER, GEORGIA, FROM SKULL SHOALS TO THE GEORGIA RAILROAD BRIDGE.

UNITED STATES ENGINEER OFFICE,
Montgomery, Ala., October 26, 1884.

SIR: In compliance with letter of September 4, 1884, from office of the Chief of Engineers, I have caused a preliminary examination to be made of the Upper Oconee River, Georgia, from Skull Shoals to the Georgia Railroad Bridge, for the purpose of ascertaining whether this portion of the Oconee River is worthy of improvement and the probable cost of making a further survey and report contemplated by the river and harbor act of July 5, 1884, including the project and estimate of cost of improvement proper to be made.

This examination has been made under my direction by Assistant Engineer C. A. Locke, in local charge of the improvement of the Oconee and Ocmulgee rivers. For detailed information attention is invited to his report, which is transmitted herewith, and to communications from James B. Park, Vice-President Powell's Mills (Skull Shoals) Steamboat Company, and from W. S. Barnes, agent Georgia Railroad at Oconee (Georgia Railroad Bridge). While it appears from this examination that a section of the Oconee River some 20 miles in length can be made navigable at comparatively small expense, and that the benefit to the trade of the adjoining country would amply justify the expenditure, yet it appears further that unless the Oconee River below the Georgia Railroad Bridge be worthy of improvement, and can be made navigable at a cost which will be justified by the resulting benefit to trade along the river, the improvement now contemplated must be and remain a purely local one. For this reason, while I am of the opinion that this improvement is worthy to be made, I am further of the opinion that the survey, project, and estimate of improvement proper to be made should include that portion of the Oconee River between the Georgia Railroad Bridge and Milledgeville, Ga.

The cost of the necessary survey between Skull Shoals and the Georgia Railroad Bridge for an improvement contemplating 20 inches depth of channel at extreme low water is estimated at $250.

To continue this survey down the river to Milledgeville would cost about $300.

Very respectfully, your obedient servant,

R. L. HOXIE,
Captain of Engineers, U. S. A.

The CHIEF OF ENGINEERS, U. S. A.

REPORT OF MR. C. A. LOCKE, ASSISTANT ENGINEER.

GREENSBOROUGH, GA., *October* 24, 1884.

CAPTAIN: In reply to the second requirement of your order of 15th instant, I respectfully submit the following in regard to the commercial needs, present and prospective, of the country tributary to the Oconee River between Skull Shoals and Georgia Railroad Bridge.

For the following reasons, I consider the work worthy of an examination:

1. Throughout the entire distance the river is either straight or of such easy curves that boats suited to it could steer the entire distance without working (backing, &c).

2. The cost of improving it so that boats could run three-fourths of the year would be quite moderate.

3. The best lands of this section lay along its banks. They are level, well drained, very productive, and, exclusive of the hills surrounding these bottom lands, cover an area of about 16 square miles. All along on these lands I found a most luxuriant natural growth of Bermuda grass, and believe the future of that industry promises much. Interested parties say that 10,000 bales of cotton are annually made in the country tributary to this work. I estimate it at 6,000 or less bales. Much guano is used there in the spring.

4. This country trades with the following towns distant from Skull Shoals as follows:

	Miles.
From Skull Shoals to Maxey's	8
From Skull Shoals to Greensborough	13
From Skull Shoals to Madison	16
From Skull Shoals to Athens	20

The principal portion of this trade goes to Athens and Greensborough. The roads are very hilly, and in winter a stiff red clay makes them very bad.

5. The best citizens favor the project, and take a lively interest in its success.

6. At Skull Shoals there is a four-story brick factory, about 50 by 100 feet; a three-story frame grist-mill, about 40 by 70 feet, of four run of stones; a one-story brick warehouse, a store, shop, covered bridge, and dwellings for 125 factory employés.

The factory has 3,848 spindles, with accompanying machinery for spinning; one laying and fanning machine for rope. On an average the year round the factory has consumed 75 bales of cotton per month. It has also 120 looms, which have not been run for years.

The owners of this factory, Rieves & Nicholson, Athens, Ga., feel especial interest in this work.

7. From Railroad Bridge to Park's Mill, 3½ miles below, is always navigable. At this place is a grist-mill of four run of stones and a store-house.

Secondly. The following reasons are unfavorable to the prosecution of the work:

1. It is conveniently local, and probably will remain so in future, since the Oconee River above Milledgeville to Georgia Railroad Bridge has many heavy shoals over metamorphic rocks.

2. The distance to be improved is very short, probably 17 miles exclusive of that already navigable below the bridge.

3. It is a custom of small planters to go in person with their cotton to market, and very generally such cotton has had advances made on it by merchants who would insist that the cotton be delivered to them at their place of business. Oconee Station is not a trading point, hence cotton would probably seek the other markets.

4. The river would not be navigable when probably two-thirds of the cotton crops was being marketed, but would be with all of the guano.

Finally, I think if the river was improved it is probable that a boat would be placed upon it owing to the freight of the factory, the larger planters owning farms near Skull Shoals and Park's Mill below.

Very respectfully, your obedient servant,

C. A. LOCKE,
Assistant Engineer.

Capt. R. L. HOXIE,
Corps of Engineers, U. S. A.

LETTER OF THE VICE-PRESIDENT OF POWELL'S MILLS STEAMBOAT COMPANY.

GREENSBOROUGH, GA., *October* 23, 1884.

DEAR SIR: I herein submit what I consider would be the commercial importance, present and prospective, in opening the Oconee River to steamboat navigation from Powell's Mills to the Georgia Railroad bridge, a distance of about 20 miles.

This line embraces a fine agricultural country, adapted to cotton, corn, hay, and small grain, averaging about 10 miles on each side of said river, which now has no railroad or other public transportation to market, nor is there now any prospect of a railroad being built, and by making this part of the river navigable for steamboats it would give a convenient access to market, and would thus encourage production and enhance the value of property in that section at least 50 per cent. in a very short time. This section embraces some of the most fertile lands in this country, and its large products have now to be transported to market by private means, some 15 to 20 miles, at great personal inconvenience.

Very respectfully, &c.,

JAS. B. PARK,
Vice-President Powell's Mills Steamboat Company.

C. A. LOCKE,
Assistant Engineer.

STATEMENT OF THE AGENT OF THE GEORGIA RAILROAD AT OCONEE.

OCONEE, GEORGIA RAILROAD, *October* 24, 1884.

Cotton shipped from Oconee, 1880	bales..	350
Guano shipped to Oconee, 1880	tons..	50
Corn and oats shipped to Oconee	car-loads..	10
Passenger fare		$800
Freight shipped, miscellaneous		100
Freight earnings	received..	1,400

W. S. BARNES,
Agent.

SURVEY OF UPPER OCONEE RIVER FROM SKULL SHOALS TO THE GEORGIA RAILROAD BRIDGE.

UNITED STATES ENGINEER OFFICE,
Montgomery, Ala., January 30, 1885.

SIR: In compliance with letter of November 21, 1884, from the office of the Chief of Engineers, I have the honor to submit the following report upon a survey made in compliance with section nine of the river and harbor act approved July 5, 1884, of the Upper Oconee River, from Skull Shoals to the Georgia Railroad Bridge.

An instrumental survey of this river was made by Mr. C. A. Locke, assistant engineer, and the cost of improvement for the 21 miles included between these limits is estimated at $1,500. This would give a channel having a least depth of 20 inches at low water, and a width sufficient for navigation between the railroad bridge and Skull's Shoals, otherwise known as Powell's Mill.

In the report of preliminary examination it was shown that this locality was eminently worthy of improvement, but that the improvement might be considered a local one unless it should appear that the river intervening between the railroad bridge and Milledgeville was susceptible of improvement, at a cost fairly proportioned to the benefit to be derived therefrom. The examination of the river was, therefore, continued down to Milledgeville, and the river was found to be of such character, requiring a system of locks and dams for its improvement, that it must be considered as isolating the upper river, and making the improvement between Skull's Shoals and the Georgia Railroad bridge a local one. For this reason the improvement is not recommended.

I transmit herewith report of Mr. C. A. Locke, assistant engineer, who made the survey, and refer to the report of preliminary examination for statistics of commerce and navigation. It was found to be the

opinion of responsible parties that a steamboat line on this upper section of the river would secure the transportation of products to the value of $813,000 annually, the freight upon which would probably amount to $38,200.

Very respectfully, your obedient servant,

R. L. HOXIE,
Captain of Engineers, U. S. A.

The CHIEF OF ENGINEERS, U. S. A.
(Through Lieut. Col. D. C. Houston, Corps of Engineers, U. S. A., Supervising Engineer.)

[First indorsement.]

JACKSONVILLE, FLA., *February* 6, 1885.

Respectfully forwarded to the Chief of Engineers with Captain Hoxie's report of January 30, 1885.

I approve his recommendations.

* * * * * *

D. C. HOUSTON,
Lieut. Col. of Engineers, Bvt. Colonel, U. S. A.

REPORT OF MR. C. A. LOCKE, ASSISTANT ENGINEER.

MONTGOMERY, ALA., *February* 2, 1885.

CAPTAIN: In the general survey of the Oconee River, between Skull Shoals and Milledgeville, the descents and distances were found to be as in the accompanying table, where they are given in a general classification.

I estimate without any measurements the summer flow of water at Milledgeville about 2,000 cubic feet per second, at Georgia Railroad Bridge about 1,200 cubic feet per second, and at Skull Shoals about 400 cubic feet per second.

I estimate the cost of improving the Oconee River, between Skull Shoals and the Georgia Railroad Bridge, so as to give a channel 20 inches in depth and having a least width of 40 or 50 feet, as follows:

Cost of working plant	$400
Removal of rock obstructions	500
Removal of snags and overhanging trees	350
Engineering and superintendence	250
Total	1,500

If the river were to be improved between the Georgia Railroad Bridge and Milledgeville, the most suitable improvement would probably consist of locks of low lifts, 8 feet or less, with dams crossing the channel, or portions of it, so that the minor channels between the islands might be utilized rather than a canal. I do not think that less than 14 of such locks would be required on the shoals proper. On the reaches between the shoals it is possible to get a channel by concentrating the water with dams and blasting the reefs and prominences. Generally speaking, material for rock-dams is not easily accessible along the river.

The total cost of the work below Park's Mill (Georgia Railroad Bridge) would be very far beyond any benefits to be derived from it or any necessity for it, and the non-improvement of this would leave that above the mill purely a local route of only 21 miles in length.

Very respectfully,

C. A. LOCKE,
Assistant Engineer.

To Capt. R. L. HOXIE,
Corps of Engineers, U. S. A.

List showing the fall by sections in Oconee River, Georgia, between Skull Shoals and Milledgeville.

[Datum plane, 500 feet below bench-mark at Skull Shoals.]

Locality, description, &c.	Distance below Skull Shoals.	Length of shoals or river.	Elevation.	Fall within the section located.	Fall per 1,000 feet.
	Feet.	*Feet.*	*Feet.*		
Low-water surface, below Skull Shoals Dam	.....	.....	479.3	.....	.....
Low-water surface at Georgia Railroad Bridge	92,500	92,500	460.3	19.0	0.20
From Georgia Railroad Bridge to W. S., below Park's mill-dam, morning of January 13; stage of water, about 5.5 feet above low water	110,500	18,000	455.3	5.0	0.28
From Park's mill, over rough water, without any perceptible fall to the eye, to head of Hill's Shoals	172,800	62,300	438.7	16.6	0.27
From head to foot of Hill's Shoals	175,000	2,200	436.7	2.0	0.91
From Hill's Shoals to head of Long Shoals, reefs of jointed gneissitic quartzite, without perceptible fall	188,700	13,700	431.4	5.3	0.39
From head to foot of Long Shoals	192,300	3,600	418.6	12.8	0.35
From Long Shoals to head of Methodist Fishery or Riley's Shoals	196,100	3,800	417.0	1.6	0.42
From head to foot of Methodist Fishery	199,800	3,700	388.2	28.8	7.78
From foot of last to head of Laurin's Shoals	202,400	2,600	386.5	1.7	0.65
From head of Laurin's to foot of first division of Laurin's Shoals	208,900	6,500	377.7	8.8	1.35
From head to foot of second division Laurin's Shoals	211,300	2,400	372.6	5.1	2.12
From head to foot of third division Laurin's Shoals	215,700	4,400	365.0	7.6	1.72
Totals for what is probably all Laurin's Shoals	.....	13,300	.....	21.5	1.62
From Laurin's to end of shoal water below	222,100	6,400	358.0	7.0	1.09
Elevation of water surface from rise of river, night of January 16	222,100	.....	361.1	.....	.....
From last to lower end of even river, running through formation of mica schist (?) to ——	279,200	57,100	337.3	23.8	0.42
From last to head of Fraley's Shoals, over an even river, interrupted about each half mile by reefs of gneiss, without perceptible fall to the eye	332,700	53,500	297.7	39.6	0.73
From head to foot of Fraley's Shoals	334,800	2,100	291.7	6.0	2.85
From last to head of next shoals	338,800	4,000	290.8	0.9	0.23
From last to probable head of Furman's Shoals	351,200	12,400	281.4	9.4	0.77
From head to foot of Furman's Shoals	358,000	68,000	263.0	18.4	2.71
From foot of Furman's to head of McKinley's	367,600	9,600	260.6	2.4	0.25
From head to foot of McKinley's Shoals	368,800	1,200	258.6	2.0	1.66
From foot of McKinley's Shoals to water surface (4 feet above low water) below the dam of mill at Milledgeville	377,650	.....	253.2	5.4	0.61
Difference of elevation of low water at Georgia Railroad Bridge and below	92,500	.....	460.3	.....	.....
Milledgeville mill-dam	377,600	285,100	249.2	211.1	0.74
Elevation of (grade) Georgia Railroad Bridge, above Park's mill	.....	.....	496.6	.....	.....
Elevation of M. & A., above Milledgeville (bridge)	.....	.....	309.3	.....	.....
Elevation of Co. R. R. depot, Milledgeville	.....	.....	330.6	.....	.....

APPENDIX Q.

IMPROVEMENT OF THE HARBOR OF MOBILE; OF WARRIOR, TOMBIGBEE, AND BLACK WARRIOR RIVERS, ALABAMA, AND OF CERTAIN RIVERS IN MISSISSIPPI—IMPROVEMENT OF CHANNEL TO BILOXI BAY, AND OF HORN ISLAND PASS.

REPORT OF MAJOR A. N. DAMRELL, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1885, *WITH OTHER DOCUMENTS RELATING TO THE WORKS.*

IMPROVEMENTS.

1. Mobile Harbor, Alabama.
2. Warrior River, Alabama.
   Tombigbee River, from Fulton to Vienna.
   Tombigbee River, below Vienna.
3. Black Warrior River, from Tuscaloosa to Daniel's Creek, Alabama.
4. Old Town Creek, Mississippi.
5. Noxubee River, Mississippi.
6. Pascagoula River, Mississippi.
7. Roadstead leading into Back Bay, Biloxi, and Biloxi Channel, Mississippi.
8. Horn Island Pass, Mississippi.
9. Pearl River, Mississippi, below Jackson.
10. Pearl River, Mississippi, from Jackson to Carthage.
11. Pearl River, Mississippi, between Edinburg and Carthage.

EXAMINATIONS AND SURVEYS.

12. Homosassa Bay, Florida.
13. Back Bay at Handsborough, Mississippi.
14. Mobile River and Harbor, from lower anchorage up to the northern limits of the city of Mobile, with a view to securing twenty-three feet depth of water.

UNITED STATES ENGINEER OFFICE,
Mobile, Ala., August 11, 1885.

SIR: I have the honor to inclose herewith annual reports for fiscal year ending June 30, 1885, for the works of improvement under my charge.

Very respectfully, your obedient servant,

A. N. DAMRELL,
Major of Engineers.

The CHIEF OF ENGINEERS, U. S. A.
(Through Lieut. Col. D. C. Houston, Supervising Engineer.)

Q 1.

IMPROVEMENT OF THE HARBOR AT MOBILE, ALABAMA.

The improvement of the channel of the harbor at Mobile, Ala., was begun by the General Government in 1827, the depth of water then being 5½ feet through Choctaw Pass and 8 feet on Dog River Bar.

The appropriations from 1827 to 1857 were as follows:

By act of Congress, May 20, 1826	$10,000 00
By act of Congress, March 2, 1829	20,000 00
By act of Congress, June 23, 1834	10,000 00
By act of Congress, March 3, 1835	17,997 60
By act of Congress, March 3, 1837	50,000 00
By act of Congress, July 7, 1838	50,000 00
By act of Congress, August 30, 1852	50,000 00
	207,997 60
By act of Congress, March 3, 1857, relief claim	20,833 08
Total	228,830 68

The result obtained was a channel 10 feet deep and 200 feet wide through the pass, and the same depth, with width unknown, over the bar. In 1860 the channel through the pass was found to have shoaled to 7½ feet, the depth of water on the bar remaining the same.

No further improvement was attempted until 1870.

From 1870 to 1875 the following amounts were appropriated for the purpose of obtaining a depth of 13 feet.

By act of Congress, July 11, 1870	$50,000
By act of Congress, March 3, 1871	50,000
By act of Congress, June 10, 1872	75,000
By act of Congress, March 3, 1873	100,000
By act of Congress, June 23, 1874	100,000
By act of Congress, March 3, 1875	26,000
Total	401,000

This amount was expended in dredging a channel 13 feet deep and 300 feet wide from the mouth of Mobile River through "Choctaw Pass," and in deepening and extending that through "Dog River Bar" to the 13-foot curve in the bay. The work was completed in September, 1876, and the channel remained practically as it was dredged until the commencement of the present project, February 19, 1881.

In 1878 a survey was directed to be made in order to determine whether the existing channel could be improved to a depth of 22 feet, and for this purpose Congress, by act of June 18, 1878, appropriated the sum of $10,000.

The survey was made and a report was submitted to the Chief of Engineers suggesting several plans of improvement. In March, 1880, it was finally decided to continue the former improvement by dredging to a depth of 17 feet with a uniform width of 200 feet from the 17-foot curve in Mobile River to the curve of the same depth in the lower bay, the estimated cost being $820,000.

From 1878 to June 30, 1885, the following amounts have been appropriated:

By act of Congress June 18, 1878 (survey)	$10,000
By act of Congress March 3, 1879	100,000
By act of Congress June 14, 1880	125,000
By act of Congress March 3, 1881	100,000
By act of Congress August 2, 1882	125,000
By act of Congress July 5, 1884	200,000
Total	660,000

Under authority of the act of March 3, 1879, bids for dredging were called for and opened May 20, 1880, but all being considered too high were rejected and the work readvertised. In the meantime, June 14, 1880, Congress appropriated an additional amount of $125,000, and the contract for the total amount of $225,000 was awarded to George C. Fobes & Company, of Baltimore, Md., at 12.3 cents per cubic yard, the lowest bid under the previous call being 24.9 cents.

The contractors commenced work February 19, 1881, and completed their contract November 9, 1882, removing, in accordance with the terms of the contract, 1,610,804 cubic yards.

The sum of $100,000 was further appropriated March 3, 1881, and the contract awarded to G. L. Long, of Mobile, Ala., at 11.7 cents per cubic yard. He commenced work on March 21, 1882, and finished January 24, 1883, removing 724,730 cubic yards.

On August 2, 1882, the sum of $125,000 was appropriated, and the contract awarded to R. Moore, of Mobile, Ala., at 12.3 cents per cubic yard. The work was began January 24, 1883, and finished February 9, 1884, the contractor having removed 888,093 cubic yards.

No further appropriation having been made and the funds available being exhausted, work on the harbor was suspended.

Congress, by act July 5, 1884, made an appropriation of $200,000 to continue the improvement, and the contract was awarded to Tobias Burke, of Mobile, Ala., at 9 cents per cubic yard. (See Abstract.)

Two alterations have been made in the original project.

First. On account of the sharp bend and nature of the material at the mouth of Mobile River, the width of the channel, as far as the upper gap of the obstructions, a distance of 3,820 feet, will be increased to 300 feet.

At the upper gap there is a deflection in the direction of 34° 6′ to the right, and 993 feet further south another of 28° 53′, on account of which the channel will be dredged 400 feet; the remaining portion of the channel between the obstructions, in length equal to 4,616 feet, will be 250 feet in width.

Second. It was also deemed advisable, on account of the low tides during the winter months, to increase the central depth to 18 feet at mean low tide of 17 feet.

The condition of the channel previous to the commencement of the present improvement was such that vessels loading to a greater depth than 12½ feet had to have their cargoes lightered or rafted to and from the city, a distance of 28½ miles, at great expense and frequently at considerable loss.

The contractor, Mr. Tobias Burke, commenced operations on September 19, 1884, and the progress of the improvement during the fiscal year ending June 30, 1885, has been as follows:

First. The total number of cubic yards of material removed during the present fiscal year, according to the terms of the contract, = 1,296,841.

Second. Those portions of Cut No. 3, remaining undredged at the end of the fiscal year of 1883–1884, have been removed, giving a minimum width of 125 feet, and central depth of 17 feet at mean low tide, from the curve of that depth in Mobile River to same curve in the lower bay.

Third. From Cluster No. 31, which is at the elbow on Fowl River Shoals, the fourth cut has been dredged to the southern entrance, a distance of 9.88 miles, increasing the width to 145 feet.

Fourth. From Cluster No. 31 to 2,266 feet south of cluster No. 35; also from Cluster No. 38 to 1,112 feet south of Cluster No. 40, a total distance

of 3.01 miles. Cut No. 5 has been removed, increasing the width to 190 feet.

A careful survey of the entire channel was made during the spring and summer of 1885, and its condition was found to be as follows:

First. Commencing at the 18-foot curve in the Mobile River the course of the channel is south 39° 20′ east (true course) 26 miles to cluster of Piles No. 1; there it is deflected 1° 49′ to the left, bearing south 41° 49′ east 330 feet to Pile No. 1, located on the end of Pinto Island Spit. At Pile No. 1 the course of the channel turns 15° 27′ further left, and bears south 56° 26′ east to the upper gap of the obstructions, a distance of 4 miles. This entire portion of the channel is what is known as Choctaw Pass, is 72 miles in length, and has a central depth varying from 20 feet to 23 feet. The distance between the top of the slopes = 180 feet (the depth outside of dredged channel is 12 feet), and throughout a width of 140 feet it is 17 feet deep, and for a width of 100 feet it is 19 feet deep at mean low tide. It was originally dredged 145 feet wide, with depth of 19 feet. The nature of the material is a stiff blue clay, with a top layer of sand 2½ feet maximum thickness for about 1,610 feet.

In the spring of 1881 a single cut of 35 feet was made and almost immediately refilled. In the fall of 1882 four cuts were taken out at once. There is no evidence of any shoaling since; on the other hand, it has increased both in central depth and width.

Second. At the upper gap of the obstructions a bend of 34° 6′ to the right was made, the channel bearing south 22° 20′ east to Cluster No. 2, a distance of 993 feet, and was dredged in 1881 and 1882 245 feet wide and 18 feet deep. This portion has now a minimum central depth of 20 to 21 feet; width between top of slopes is 290 feet; is 18 feet deep throughout 250 feet, and 19½ feet deep, with a width of 160 feet.

Third. At Cluster No. 2 the course of the channel was further deflected to the right 28° 53′, bearing south 4° 33′ west to the lower gap of the obstructions, a distance of 4,616 feet = .87 mile, was originally dredged 105 feet wide and 18 feet deep in 1881–1882; this portion has now a central depth of 19 feet to 20 feet; width between top of slopes is 150 feet, is 17 feet deep throughout 110 feet, and has a depth of 18 feet to 19 feet for 90 feet in width.

The nature of the material between the obstructions is a mixture of clay and sand, the quantity of the latter gradually diminishing until the lower gap is reached, where the material is comparatively free of sand.

Fourth. At the lower gap of the obstructions the direction changes 12° 24′ minutes to the right, bears south 15¼° west to Cluster No. 5, north end of the elbow on Dog River Bar, a distance of 1.79 miles. The elbow is .26 mile in length, makes an angle of 10° 14′ to the left, and bears south 5° west to Cluster No. 6.

At Cluster No. 6 the channel is changed in direction 10° 17′ to the left, bearing south 5¼° east to Cluster No. 31, a distance of 12.63 miles. The nature of the material from the obstructions to Cluster 11 is a stiff blue clay, comparatively free of sand or sediment between Clusters 11 and 12, is the crest of the Dog River Bar, and the substratum of clay being covered with a layer of compact sand from 0 to 2½ feet in thickness; from Cluster No. 12 to Cluster No. 20 (3.98 miles) the material is entirely free from sand. At Cluster No. 20 commences the shell reefs of the Fowl River Shoals, extending south to Cluster No. 29 about 4½ miles from Cluster No. 29 to Cluster No. 31; the material is the same as above the shoals.

From the lower gap of the obstructions to Cluster No. 31 three cuts have been dredged with total width of 105 feet and depth of 17 to 18 feet.

This portion of the channel has now a central depth of 17½ to 18½ feet, with a bottom width of 50 feet and distance between top of slopes of 140 feet.

There is one shoal place in this part of the channel with a depth varying from 16 feet to 18 feet between Pile No. 14 and 1,470 feet south of Cluster No. 7, 127 miles in length. This shoal extends north and south of the experimental cut of 22 feet, recommended by the Board of Engineers in their report of February 28, 1880 (page 1065, Part II, Report of Chief of Engineers, 1880).

The cut is located in the elbow on Dog River Bar; was dredged in September, 1882, with a width of 100 feet, length of 300 feet, and depth of 22 feet at mean low tide. It was sounded in February, 1884, and a minimum central depth of 20 feet was found, and a depth of 17 feet throughout a width of 125 feet. In May, 1885, the cut was again examined, and the center depth was found to be from 18½ feet to 19½ feet, with a depth of 17 feet 125 feet broad, the width between the tops of the slope being 165 feet. It would therefore appear that the diminisheed depth is due to the sides and ends of the cuts assuming the natural slope of the material composing the bottom, as it was originally dredged with perpendicular banks 100 feet apart. The depth of water outside of the channels at the lower gap and the experimental cut is 10 feet, then gradually increases to 13 feet at Cluster No. 14, which is the end of the 13-foot channel; decreases to 12½ feet on Fowl River Shoals and is this depth at Cluster No. 31.

Fifth. Cluster No. 31 is at what is known as the "Fowl River Shoals Elbow." Here the course of the channel is deflected 13° 40′ to the right, bearing south 7¼° west 9.88 miles to the 17-foot curve in the lower bay, and is so located that the northern extremity of the curve of 22 feet may be reached without further change in the course.

Sand Island light-house is exactly in range with the west bank and distinctly visible at Cluster No. 31.

From Cluster No. 31 to 2,266 feet south of Cluster No. 35 (2.47 miles) the present width is 190 feet with a depth of 18½ feet having a width of 100 feet; from this point to Cluster No. 38 (1.15) miles) the width is 125 feet, with a depth of 18½ feet throughout 50 feet; from Cluster No. 38 to 1,112 feet south of Cluster No. 40 (1.24 miles) Cuts Nos. 4 and 5 have been dredged, giving a width of 100 feet between the top of the slopes and bottom width of 100 feet with 17½ feet depth; from this latter point to Cluster No. 43 (1.35 miles) the top width is 200 feet and a depth of 16½ to 17 feet throughout 60 feet; and lastly from Cluster No. 43 to Cluster No. 50 (3.67 miles) the top width is 200 feet, with a width of 50 feet, having a depth of 19 feet to 20 feet of water at mean low tide.

The nature of the material is comparatively firm from Cluster No. 31 to Cluster No. 45. From Cluster No. 45 it gradually becomes soft, and offers but slight resistance to vessels of 1 foot greater draught than the depth of water.

The natural slope is very flat, and consequently considerable shoaling has taken place, and will continue to do so until sufficient width has been attained.

Condition of the improvement June 30, 1885.

Sections.	Dredged 1881–1885.			Re-examined June and July, 1885.	
	Length.	Width.	Depth.	Minimum top width.	Minimum center depth.
	Miles.	*Feet.*	*Feet.*	*Feet.*	*Feet.*
Initial point Mobile River to Upper Gap of the obstructions	.72	145	19–20	180	20 –23
Upper Gap to Cluster No. 2	.19	245	18–19	290	20 –21
Cluster No. 2 to Lower Gap	.87	105	18–19	150	19 –20
Lower Gap to Fowl River Elbow (Cluster 31)	14.68	105	18–19	140	17½–18½
Fowl River Elbow to 2,268 feet south of Cluster No. 35	2.47	175	18–19	190	17½–18½
2,268 feet south of Cluster No. 35 to Cluster No. 38	1.15	135	18–19	125	17½–18½
Cluster No. 38 to 112 feet south of Cluster No. 40	1.24	175	18–19	190	17½–18½
112 south of Cluster No. 40 to Cluster No. 43	1.35	125	18–19	200	16½–17½
Cluster 43 to southern end of channel	3.67	125	18–19	200	17½–18½

That portion of the river from which the wrecks of the brig New York and the lighter Arlington were removed March, 1884, was unsurveyed during May, 1885. No portions of the wrecks were found, and on the site of the New York there is now 16.6 feet of water, and 10 feet on that of the Arlington. The shoal in the river at the foot of Charleston street, below the New York, has decreased in length about 80 feet, and depth of water increased six-tenths of a foot. The shoal at the foot of Monroe street, north of the wrecks, remains unchanged, while the curve of 18 feet in depth has been more uniform.

Length of each cut dredged.

Cuts.	Wide.	Length.
	Feet.	*Miles.*
Cut No. 1	40	26.35
Cut No. 2	35	26.35
Cut No. 3	35	26.35
Cut No. 4	30	10.79
Cut No. 5	45	3.90
Cuts Nos. 6 and 7	35	.38

NUMBER OF CUBIC YARDS OF MATERIAL REMOVED FROM THE CHANNEL FROM COMMENCEMENT OF PRESENT PROJECT TO JUNE 30, 1885.

	Cubic yards.
Under contract, George C. Fobes & Co	1,610,804
Under contract, G. L. Long	724,730
Under contract, R. Moore	888,093
Under contract, Tobias Burke (1884–'85)	1,296,841
Total	4,520,468

The amount of material remaining to be removed in order to complete the improvement as at present projected is approximately estimated for a 17-foot channel (allowing 20 per cent. increase of volume) to be 2,340,513 cubic yards, and allowing 1 foot from the initial point in the river to Cluster No. 31, and 1½ feet from Cluster No. 31 to the southern

entrance, the amount to be removed is approximately estimated at 2,944,883 cubic yards, distributed as follows:

Locality.	17 feet.	18 feet.
	Cubic yards.	*Cubic yards.*
From the initial point in the river to the Upper Gap, .72 mile in length, 150 feet wide	89,680	102,437
From Upper Gap to Cluster No. 2, .19 mile length, 140 feet width	24,024	30,180
From Cluster No. 2 to Lower Gap, .87 mile length, 140 feet width	66,420	94,698
From Lower Gap to Cluster No. 31, 14.68 miles length, 90 feet wide	1,468,570	1,774,522
From Cluster No. 31 to 2,266 feet south of Cluster No. 35, 2.47 miles in length, 40 feet wide	708,286	125,497
From 2,266 feet south of Cluster No. 35 to Cluster No. 38, 1.15 miles length, 90 feet width	84,754	131,197
From Cluster No. 38 to 1,112 feet south of Cluster No. 40, 1.24 miles length, 40 feet wide	48,815	56,047
From 1,112 feet south of Cluster No. 40 to Cluster No. 43, 1.35 miles in length, 120 feet wide	139,532	196,610
From Cluster No. 43 to southern entrance, 2.67 miles in length, 120 feet wide	330,432	433,691
Total	2,360,513	2,944,883

Prior to October, 1882, all vessels of greater draught than 11½ feet to 12 feet, with very few exceptions, anchored in the lower bay, and their cargoes in and out were lightered to and from the port, a distance of 28½ miles, at great cost, loss of time, and frequently considerable loss of cargo.

The channel of 17 feet in depth, with a width of 75 feet, was opened in October, and during the business season of 1882–'83 all vessels of every description entering the bay came up to the wharves of the port, there took on full cargoes or loaded to an average draught of 16½ feet, and in many cases from 17 feet to 17½ feet; then passed through the channel to sea or to the lower anchorage, where they finished loading to 22½ feet, 23 feet being the depth at mean low tide on the outer bar. But owing to the great damage done the channel by vessels getting on the banks, causing delay, as well as pressing the material into the dredged channel, thereby diminishing the depth, it was deemed best to limit the draught to 15½ feet to 16 feet; consequently the average draught during 1883, 1884, and 1885 has been 15½ feet, the maximum draught being 17 feet. No material delay in passing through the channel was experienced.

The improvement so far as it has progressed has given general satisfaction.

The amount of funds available during the fiscal year ending June 30, 1886, will be expended in removing those portions of Cuts 4 and 5 remaining to be dredged between the Fowl River Elbow (Cluster No. 31) and the southern entrance, and as much of Cut No. 6 as possible. The amount available will probably increase the width of this portion to 200 feet.

The amount of $240,000 could be profitably expended during the fiscal year ending June 30, 1887, and would carry to successful completion the improvement as at present projected.

A small amount may be required to redredge that portion of the Fowl River Elbow that has shoaled to 16 feet, caused by the narrowness of the channel and the soft nature of the material.

The amount that has been appropriated toward increasing the depth from 12½ feet to 17 feet at mean low tide is $660,000.

The total expended by the General Government on the improvement of the channel of Mobile Harbor since 1827 is $1,289,830.38, resulting in a gain of depth from 5½ feet to 17 feet.

The benefits to be derived from the improvement when completed are as follows:

The saving of 28½ miles of lighterage, which on cotton alone during the fiscal year amounted to at least $32,000; the large increase of shipping seeking this port, which in 1881–'82 amounted to 243 vessels, with a tonnage of 100,719, and in 1884–'85 to 310 vessels, with a tonnage of 136,144; the greater facility and safety in discharging and loading at the wharves of the port.

The improvement is located in collection district of Mobile, Ala. Mobile is the nearest port of entry, and is situated at the northern entrance of the projected channel, 26⅓ miles from the southern entrance to the same, and 36 miles from the outer bay buoy in the Gulf of Mexico.

Money statement.

July 1, 1884, amount available		$374 57
Amount appropriated by act approved July 5, 1884		200,000 00
		200,374 57
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$112,962 44	
July 1, 1885, outstanding liabilities	11,571 52	
		124,533 96
July 1, 1885, amount available		75,840 61
Amount (estimated) required for completion of existing project		240,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		240,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

Abstract of bids received and opened August 12, 1884—Dredging in Mobile Harbor, Alabama.

No.	Names of bidders.	Price per cubic yard.	Time of commencing work.	Time of completing work.
		Cents.		
1	George C. Fobes & Co., Mobile, Ala.	11½	In accordance with specifications.	In accordance with specifications.
2	James E. Slaughter, Mobile, Ala.	10.74	ditto	Do.
3	R. Moore, Mobile, Ala	10	ditto	Do.
4	American Dredging Company, Philadelphia, Pa.	14	ditto	Do.
5	Tobias Burke, Mobile, Ala	9	ditto	Do.
6	S. N. Kimball, Apalachicola, Fla.	12½	ditto	Do.
7	Benson & McNee, San Francisco, Cal.	15	ditto	Do.

COMMERCIAL STATISTICS.

The following statistical statement for the years of 1884 and 1885 was furnished by the collector of customs at this port:

ENTRANCES.

Description.	June 30, 1885.			June 30, 1884.		
	Vessels.	Tonnage.	Crew.	Vessels.	Tonnage.	Crew.
Foreign	124	73,713	1,458	165	114,141	2,238
Coastwise	37	11,128	241	66	22,555	561
American	47	17,369	330	50	9,015	352
Total	208	102,210	2,029	281	145,711	3,151

CLEARANCES.

Description.	June 30, 1885.			June 30, 1884.		
	Vessels.	Tonnage.	Crew.	Vessels.	Tonnage.	Crew.
Foreign	136	87,466	1,744	155	105,714	1,975
Coastwise	45	8,187	371	54	17,788	433
American	38	19,068	171	51	10,088	380
Total	219	114,721	2,286	260	133,590	2,788

IMPORTS AND EXPORTS.

Description.	1885.	1884.
Duties on imports	$7,513 97	$50,324 51
Tonnage dues	3,438 36	22,517 70
Hospital collections	1,470 50	3,742 79
Miscellaneous	968 75	5,012 67
Total collections	15,391 58	81,597 67
Exports to foreign ports	3,015,082 00	3,836,449 00
Imports of foreign goods	129,046 00	282,786 00

Mobile Cotton Exchange statistics.

Cotton receipts.	1884–'85.	1883–'84.	1881–'82.
Via Alabama River ..... bales	40,862	29,759	39,692
Via Tombigbee River ..... do	47,880	35,224	45,494
Via Warrior River ..... do	5,333	5,864	964
Via Mobile and Ohio Railroad ..... do	70,624	114,513	123,568
Via Mobile and Montgomery Railroad ..... do	65,142	68,716	59,469
Coastwise via Pensacola ..... do	10,558	6,835	2,073
Total ..... do	240,399	260,911	271,260
Coffee importations ..... sacks	27,878	19,869	23,332
Naval stores.			
Resin ..... barrels	163,437	228,015	160,971
Turpentine ..... do	37,487	43,228	25,314
Tar ..... do	.....	450	440
Pitch ..... do	.....	2,000	2,750
Salt imported from Liverpool direct ..... sacks	.....	29,582	28,398
Salt imported from Liverpool indirect ..... do	.....	1,986	8,588
Salt imported from Vermillion Bay ..... do	.....	.....	75,557
Total	.....	31,568	112,543

Comparative statement of shipments of cotton to foreign and coastwise ports.

Direction.	Bales.	1885.	1884.	1881.
		Value.	Bales.	Bales.
Foreign by vessels	43,830	$2,308,581	57,537	46,366
Coastwise by vessels	25,559	1,346,958	16,383	.....
Interior by rail	190,095	10,016,006	186,991	224,894
Total	259,484	13,671,545	260,911	271,260

Number and character of vessels engaged in the traffic of Mobile Harbor, Alabama.

Description.	1885.		1884.		1881.	
	No.	Tonnage.	No.	Tonnage.	No.	Tonnage.
Steamers	4	558	4	491	4	877
Sloops	28	139	21	122	17	75
Schooners	70	1,311	59	1,139	24	843
Tugs	29	1,474	24	1,501	12	1,181
Barges	24	1,509	21	1,375	31	2,394
Fishing smacks	11	346	10	314	6	170
Total	166	5,337	139	4,942	94	5,540

Comparative statement of timber, lumber, &c., shipped by vessels to foreign and coastwise ports.

Description.	1885.		1884.	1881.
		Value.		
Lumber:				
Foreign ..... feet B. M.	15,388,808	$178,622	15,120,905	11,531,246
Coastwise ..... do	6,881,895	75,197	5,643,803	9,587,562
Total	22,270,703	253,819	20,764,708	21,118,808
Timber, sawn and hewn:				
Foreign ..... feet	37,443,672	385,426	40,735,536	20,326,056
Coastwise ..... do	.....	.....	349,632	131,832
Total	.....	.....	41,085,168	20,457,888
Shingles:				
Foreign ..... number	686,800	1,545	1,778,500	3,900,000
Coastwise ..... do	900,000	2,025	1,197,000	2,160,000
Total	1,586,800	3,570	2,975,500	6,060,000
Staves:				
Foreign	94,261	11,947	64,544	91,462
Coastwise	150,000	.....	6,000	.....
Total	244,261	11,947	70,544	91,462

Mobile Produce Exchange statistics.

Articles.	1885.	1884.	1881.
Fish and oysters ..... value	$250,000	$210,000	$150,000
Vegetables ..... do	200,000	232,480	174,483
Wool ..... pounds	450,000	340,000	325,786
Alabama coal ..... tons	30,310	19,598	8,189
Pennsylvania and English coal ..... do	573	891	2,701
Bagging ..... rolls	20,939	18,471	9,257
Cotton ties ..... bundles	13,337	49,686	42,315
Bacon ..... casks	7,856	7,482	8,829
Flour ..... barrels	109,003	100,079	90,013
Molasses ..... do	4,447	5,084	5,773
Sugar ..... hogsheads	2,362	3,926	4,035
Whisky ..... barrels	6,204	5,945	7,954
Pork ..... do	1,268	2,439	1,874
Fertilizers ..... sacks	88,193	97,433	57,062
Corn ..... do	215,010	370,417	345,307
Bran ..... do	47,491	55,491	43,996
Hay ..... bales	30,302	40,891	27,490
Tobacco ..... boxes	18,280	18,771	17,404

Number of vessels entering and clearing at the port of Mobile, Alabama.

1881–1882.

Description.	In port June 30, 1882.	Tonnage.	Cleared.	Tonnage.	Cargoes.				Ballast.			
					Foreign.		Coastwise.		Foreign.		Coastwise.	
					In.	Out.	In.	Out.	In.	Out.	In.	Out.
Steamers	.....	.....	3	1,514	1	3	.....	.....	1	.....	1	.....
Ships	.....	.....	13	14,802	1	12	1	.....	10	.....	1	1
Barks	9	3,632	78	51,642	4	63	5	6	64	0	4	9
Brigs	.....	.....	23	6,127	4	10	7	13	3	0	9	0
Schooners	8	327	109	22,675	24	50	17	53	9	1	67	5
Total	17	3,959	226	96,760	34	138	30	72	87	1	82	15

1884–1885.

Steamers	.....	.....	4	2,076	.....	.....	2	3	.....	.....	2	1
Ships	1	1,135	11	13,326	.....	11	.....	.....	12	.....	.....	.....
Barks	3	2,203	118	79,061	18	107	1	6	97	.....	7	5
Brigs	.....	.....	17	5,284	3	16	1	.....	12	.....	1	1
Schooners	14	3,015	142	29,944	49	55	52	63	23	2	32	22
Total	18	6,353	292	129,691	70	189	54	72	144	2	42	29

Q 2.

IMPROVEMENT OF WARRIOR AND TOMBIGBEE RIVERS, ALABAMA AND MISSISSIPPI.

WARRIOR RIVER.

The examination and partial survey of this river was made in 1874, and the report thereon may be found in the Report of the Chief of Engineers for 1875, Part II, page 16.

In its original condition the river was navigable for boats of 2,000 bales capacity during the winter and spring as high as Tuscaloosa, the depth of water during this period (usually about five months) seldom falling below 10 feet. With less water than this the snags became dangerous, and with the stage reduced to 4 or 5 feet above low water, navigation for any practical use was brought to a close.

The obstructions to low-water navigation rendering it impracticable were numerous snags and sunken logs lying mainly in the bar-chutes, but scattered along the reaches also.

Ninety bars and reefs with a ruling depth on them of 12 to 30 inches, and overhanging trees, which were also troublesome on good boating stages, often carrying away steamboat chimneys and damaging their upper works.

The improvement was authorized by act of Congress of March 3, 1875, and the project recommended and approved was to create a low-water channel of not less than 80 feet in width by 4 feet in depth, by deepening the bars, removing the snags, and cutting down the overhanging trees.

The estimated cost was $151,103.

Work was commenced in July, 1875, and has been continued annually for an average period of four months in each year.

The working time could have been doubled with advantage had the amount of funds available for the improvement permitted.

As soon as practicable after the appropriation of July 5, 1884, became available, the boats (log-boat, quarter-boat, and two barges), which had been lying in Mobile for ten months, were placed upon the ways for repairs.

These were completed by October 1, and for the next two months the boats were employed upon the lower Tombigbee, waiting an opportunity for being towed up to the mouth of the Warrior. On the 9th December work on the Warrior was resumed near its mouth, and one week later, a suitable towing stage occurring, the boats were taken to Buzzard's Bar (98 miles) for the purpose of sloping and protecting the caving bank at that place.

On the 17th January the river became too high for profitable employment of the force, and work was suspended.

Deducting the time consumed in towing, only four weeks were spent upon the improvement, and the work accomplished was:

Snags removed	54
Trees pulled back and cut up near Buzzard's Bar	213
Cords of brush cut and piled for fascines	500

The snags were taken out for a distance of 15 miles from the mouth of the river, and were fresh deposits since 1883. With the exception of the brush cut for fascines, no new work was undertaken.

The total amount of work done in the ten years during which the improvement has been in progress may be itemized as follows:

Number of months at work	42
Number of bars worked on	49
Linear feet dams and jetties built	31,080
Linear feet of wattled screens	3,069
Linear feet of bank partially sloped and planted	3,200
Number of overhanging trees cut	8,375
Number of snags and sunken logs removed	7,468
Steamboat wrecks removed	2

The aggregate length of bar improvement originally required was 14 miles. Of this distance 9.36 miles have been worked upon, leaving 4.64 miles upon which no work has been done, except snagging and bank-trimming. These two classes of work have been done thoroughly for 110 miles, and partially for the remaining 30 miles.

The results accomplished by the work as above classified are as follows:

The bank trimming and removal of wrecks, snags, and sunken logs have given a safe and easy navigation on a stage of water fully 3 feet lower than was originally practicable. This stage for boats of 3 feet draught may be taken at 1 foot above ordinary low water.

The bar improvements have generally been confined to those affording less than 2 feet. The contraction of the water-way to induce scouring was made tentatively, the channel having been made in no case less than 100 feet and most instances not less than 125 feet. It was intended to reduce these limits as experience demonstrated the necessity for such reduction in each case.

The observed effect upon the bars has been an increase of 1 to 2 feet in depth, giving for ordinary low water a depth of 3 to 4 feet, but the width carrying such depths is deficient, ranging from 30 to 60 feet.

By the term "ordinary low water," as above used, is meant the low-water stage as ascertained in 1874 and upon which the project for improvement was based.

The gauging at Tuscaloosa, made at that time, showed a discharge of

440 cubic feet per second. Since then the river has several times reached a lower point, and in 1884 was in places about 1 foot lower with a gauging of 320 cubic feet, the lowest known.

The bank sloping and planting were made experimentally, to determine if a growth could be established to protect the banks where the attacks of the current had caused caving. The results showed that, in most cases, the plants and cuttings did not have time to become rooted, before being washed away. Protection with mattresses for several years will be needed in such cases in order that the desired growth may become firmly established.

At ordinary low water the river is at present navigable for boats drawing $2\frac{1}{2}$ feet as high as Eastport, 50 miles from the mouth. Above that point the ruling depth would be 2 feet, owing to the short rock reefs at Parham's (79 miles), Burrows Rock (92 miles) and Bealis (99) miles), upon which no work has yet been done. This depth would also rule at Williford's (94 miles) and Buzzard's Bar (98 miles), where much work will be needed to re-establish and make permanent a suitable channel, the river at these points having widened so much of late years as to afford no definite channel at low water.

The work thus far executed that has been of most service to navigation is the snagging and bank-trimming. This is not a permanent improvement, however, because every year timber is thrown into the river by caving banks and by "slip-ins," which are portions of the bank 25 feet to 100 feet in length by 10 feet to 35 feet in width that here and there slough off after a high river. It also happens that after a chute has apparently been thoroughly cleared of snags, the consequent scouring away of the sand exposes buried logs, which, being disengaged, rise at one end and form new obstructions.

The cause of these obstructions will cease to exist in a few years, but the others mentioned will render annual revision necessary until stability shall have been given to the banks.

By the act of July 5, 1884, an appropriation was made for the improvement of the Warrior above Tuscaloosa. As the main business consequent upon this improvement will be coal transportation, which is expected to become the leading business upon the entire river, it is proper now to consider the project for the improvement of the lower Warrior with reference to the facilities it will afford this business.

The cost per ton in transporting coal by barges depends upon the amount carried, since the gross cost is nearly the same whether the tows be large or small.

Hence, in improving a stream for towing purposes, width becomes a matter of prime importance. Should the channel of the Warrior be limited, as proposed, to 80 feet in width and a depth of 4 feet obtained (which would not always be for the full width, however), the facilities thus afforded to single boats would be at the expense of tows.

For such a channel, often curved, as it would be, would not allow of tows of the size required for cheap transportation if it would allow them at all, and such tows would be shut out not only during low water, but until a stage had been reached sufficient to give a navigable depth over the works built for contracting the channel.

For tows drawing 5 feet a stage of 7 to 8 feet above low water would be needed.

On this account it would seem advisable to contract the channel no further than has already been done, and it will probably be better to make the limit not less than 125 feet. A 4-foot stage would probably be needed in this case to give a navigable depth throughout the entire width.

During low water this stage could possibly be secured temporarily by a system of "flushing" from the pools in the upper river, thus forming "tides" upon which tows could descend. Their ascent, with empty barges, would be practicable at any time.

The 4-foot stage may also be obtained permanently by the slackwater system, for which the gentle fall of the river (4 inches per mile for 80 miles below Tuscaloosa) offers favorable conditions.

Governed by the views above presented, I respectfully suggest a modification of the original project so far as regards the channel width, and recommend that its minimum be increased from 80 feet to 125 feet. It is expected that the funds available for expenditure during the fiscal year ending June 30, 1886, will be exhausted by December 1, 1885, except so much as may be reserved for the care of the property.

It is proposed to use them in sloping and revetting the caving bank at Buzzard's Bar, in removing the fresh log obstructions that have formed in consequence of the bank yielding, and to give the channel there a suitable position. It is expected that this season's work will accomplish these results, and probably no more.

The amount that can be profitably expended during the fiscal year ending June 30, 1887 (besides the funds referred to in the preceding paragraph), is $65,000. Of this amount $15,000 would be required in building a steamboat, needed for snagging, transporting material, and towing. It is not expected that this work can be completed by June 30, 1886, but will require one or two months' time after that date.

The estimated amount for the entire completion of the work as originally proposed is $65,000. Should the project be modified, as proposed above, there will be less jetty work required; but this will be offset by the extra work needed in widening several chutes to get the full width proposed, so that the estimate would remain as above stated. As before explained, the completed work will not be permanent, but will require annual revision, at a probable cost of $8,000.

With the improvement completed on the plan modified as proposed, it is expected that the river will afford safe and easy navigation throughout the year, with a channel during the average low-water three months not less than 125 feet wide, of a depth sufficient for boats of 2½ feet draught. For coal-tows drawing 5 feet there would be uninterrupted navigation for six months, with boating stages occurring irregularly for three months more.

The commercial advantages expected from the improvement are:

(1) The reduction of freight rates due to the competition between river and rail, amounting, as estimated in former reports, to fully $50,000 annually on the present business of the Warrior Valley.

(2) Doing away with the uncertainty, irregularity, and, in great measure, the risk heretofore attendant upon river transportation, and, consequently, reducing its cost.

(3) The utilization of the river as a channel for coal transportation to the Gulf.

A reduction of fully $1.25 per ton from present freight rates on coal from the Warrior Valley is expected, reducing wholesale prices in Mobile to $2.50 per ton.

Money statement.

Amount appropriated by act approved July 5, 1884	$12,000 00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	5,168 19
July 1, 1885, amount available	6,831 81

Amount (estimated) required for completion of existing project.....	$65,000 00
Amount that can be profitably expended in fiscal year ending June 30,1887	65,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

TOMBIGBEE RIVER.

The improvement of the Tombigbee in Mississippi was authorized by act of March 3, 1873, and its improvement below Columbus by act of March 3, 1875.

Its continuance has been provided for by appropriations made for the Black Warrior and Tombigbee jointly. The act of July 5, 1884, in appropriating funds for continuing the improvement of the Tombigbee made two divisions of the river, viz, "Fulton to Vienna" and "Below Vienna." These distinctions are accordingly observed in this report.

In its original condition the river was navigated throughout the year to Bladon Springs, the ordinary limit of tide-water, 143 miles from Mobile. During low water, however, boats were liable to detention at four bars, where at low tide the depth was sometimes reduced to 2 feet. Moreover, snags were troublesome, and at some points dangerous, so that they could be passed only in daylight.

From Bladon to Demopolis, 243 miles from Mobile, low-water navigation was difficult both from the bars on which the boats grounded, and from snags and sunken logs. At times only 18 inches could be found on some of the bars, and then the boats turned back at Bladon.

Navigation was suspended to Demopolis during two to three months annually.

From Demopolis to Columbus, 416 miles from Mobile, there were numerous bars giving but 12 to 18 inches at low water, and the channel throughout was much obstructed by snags. Overhanging trees were troublesome on all stages of water and often inflicted damage.

The passage through the railroad bridge at Jones's Bluff was difficult and unsafe for descending boats, as a projecting rock point above the bridge closed one draw-opening and caused a cross current through the other.

Navigation was carried on only in the winter and spring, the high-water season, and ceased when the river fell to a 4 or 6 foot stage above low water.

From Columbus to Aberdeen, 481 miles from Mobile, navigation was difficult with a 12-foot stage of water; to Cotton Gin Port, 516 miles, it was practicable for barges only, and to Fulton, 593 miles, there was no navigation at all.

The project for improvement recommended and approved was to open a low-water channel of navigable width, having a minimum depth of 4 feet to Demopolis, and three feet thence to Columbus. From Columbus to Fulton the river was to be cleared of snags and overhanging trees for its improvement during boating stages, open-river navigation at low water not being considered practicable.

The work was commenced in 1873, and the appropriation of $10,000 soon exhausted.

It was not resumed until August, 1878, since which time it has continued during the low-water seasons for an annual period of five months.

The time spent upon the work has been mainly devoted to snagging and bank trimming, which are essential preliminaries to bar improvement. A considerable amount of the latter work has been done during the three years in which the funds available allowed the employment of a force for that purpose.

Work during the present fiscal year was commenced on September 12, 20 miles above Columbus, and prosecuted down the river to that place. It happened that the river was not down to low-water mark when this portion of it was worked upon in previous years, and it was not practicable to remove all obstructions to as low a plane as the plan of improvement contemplated.

On the 10th of October the working party reached Columbus on a very low stage of water, having removed and cut up over 2,000 logs, fallen trees, and high stumps left from former cuttings.

On the 28th of August proposals were invited for building a barge 50×15×3 feet, and a quarter-boat 35×12×2½ feet at Columbus, the estimated cost being $1,000. Only one bid was received, which, amounting to $1,200, was thought excessive and rejected. The work was undertaken with hired labor and materials bought in open market, and completed on 10th of October, at a cost of $828.

The improvement at Huddlestone's Bar, 3 miles, and at head of "Ten Mile Shoals," 14 miles below Columbus, had been damaged by caving banks, and it was evident that the only way to make the improvement permanent was by sloping and protecting the banks. There being no rock accessible, the experiment was tried of holding the brush down by wires secured by stout stakes. Half a mile of the bank was sloped and protected in this way, the brush being also covered with earth. The result of the experiment has not yet been ascertained.

Work was supended at Christmas on account of high water. The amount done was:

Mile of bank protected	½
Trees felled and cut up	4,192
Sunken logs removed	107

Below Vienna.—On the 5th of October the log-boat Warrior, after being repaired in Mobile, was towed up to Milans's Gin, 105 miles, commenced work at that point, awaiting an opportunity for being towed up to the Warrior River. On the 5th of November, the log-boat Noxubee was returned from the Alabama and commenced work at the junction of that river with the Tombigbee, 50 miles from Mobile. Both boats worked up-stream, being aided in moving from point to point by the courtesy of passing steamboats.

The portion of river to be worked over had been well cleared of snags in former years, but had again become partially obstructed, partly from trees recently lodged and partly from the rising of old bedded logs that had been freed by the removal of overlying snags.

The snag-boat Big B was detained in Mobile until the last of November, getting a new set of boilers placed in her.

Starting out at that time, she took the log-boat Warrior and barges in tow, to the mouth of the Warrior River, arriving there December 9, and soon after towed the boats 100 miles up that river and returned to the Tombigbee.

On January 4 the river becoming too high for snagging, the Big B, with the Noxubee in tow, went above Demopolis to cut overhanging trees, where for a space of 20 miles this work had not been done.

On the 17th the work was reported finished, and the boats were ordered to Mobile.

The work done was:

Snags and logs removed below Demopolis	503
Trees felled and cut up	1,225

The steamer ran 1,130 miles, 700 of which was in towing.

The very low stage of water prevailing while the boats were engaged on the lower 100 miles of the river enabled them to do thorough work,

and steamboat officers express much satisfaction at the improved navigation afforded.

The present condition of the improvement is as follows:

1. *From Fulton to Vienna.*—From Fulton to Columbus, 177 miles, the work projected has been performed, and the river is navigable on a 4-foot stage to Aberdeen, and on an 8-foot stage to Fulton.

On lower stages the width of the channel at "Short Points" is insufficient for steamboats.

The banks are generally stable, showing little disposition to slide or cave, and, except that an occasional revision will be needed, the improvement may be considered completed.

From Columbus to Vienna the river is navigable on a 2-foot rise for boats drawing 3 feet, though for a few miles below Pickensville, the channel is difficult to run on account of snags not yet removed. With this exception the channel has been well cleared, 3,693 snags and logs having been taken out. Twenty bars that originally afforded a depth of 12 to 20 inches have been improved, and the depth increased to 3 feet. Five of them have partially shoaled again from run-bars, and will need further work. Fifteen bars giving 18 to 24 inches depth remain unimproved, and prevent low-water navigation.

2. *Below Vienna.*— The clearing of the banks from overhanging timber, and the channel from snags (3,774 having been taken out), have given safe navigation with 3 feet depth at low water to Tompkins Bluff, 197 miles.

With a 1-foot rise this depth can be carried to Kirkpatrick's, 260 miles, and with a 2-foot rise, to Vienna.

Eight bars below Demopolis, having a depth originally of 18 to 28 inches, have been improved, and the projected depth of 4 feet obtained, but in two cases not maintained.

Betwen Demopolis and Vienna fourteen bars have been improved, eleven of which maintain the 3 feet gained at first.

Fifteen bars below Demopolis and thirty above remain to be improved before the channel will have the depth designed in the project. Until this is done the full benefits of the improvements made will not be felt.

It is proposed to use the funds now available for expenditure during the year ending June 30, 1886, in completing the snagging and bank trimming above Vienna, of which there is a distance of 10 miles still to do, and afterwards to take out the scattering snags that have lodged along the river since this work was last performed. Only the snag-boat Big B will be employed, and the funds on hand will not suffice to keep her at work longer than the last of October.

The amount (exclusive of the funds on hand) that can be profitably expended during the fiscal year ending June 30, 1887, is estimated as follows:

Fulton to Vienna	$27,000
Below Vienna	60,000

The first amount includes $2,500 as the estimated cost of a new hull for the log boat, with apparatus for hydraulic grading.

The $60,000 to be applied below Vienna includes $5,000 as the estimated cost of a new hull for the snag-boat Big B.

The estimated amount needed for the entire completion of the improvement is:

Fulton to Vienna	$27,000
Below Vienna	60,000
Total	87,000

It is thought that with this amount available the improvement could be finished in twelve working months.

It is estimated that the cost of the annual revision that will be needed for the maintenance of the improvement will be $8,000.

The immediate commercial advantage that may be expected upon the completion of the improvement will arise, not so much from the increased amount of business done upon the river as from reduction of freight charges on the whole traffic of the Tombigbee Valley.

When the river is in boating condition, competition exists and rates are low.

With navigation suspended the railroads virtually monopolize the business, and charge accordingly. Now when the freight tariff shall be regulated and limited by competition, maintained perennially, the advantage to the community is evidently to be measured, not by the amount of business actually handled by the river, but by the amount affected by competitive rates, whether handled by river or rail, and this will be all of the transportation business of the Tombigbee Valley, except what may be strictly local.

The appropriations for this improvement have been made for the Warrior and Tombigbee jointly, and for the Tombigbee above Columbus as follows:

By act of March 3, 1873	$10,000
By act of March 3, 1875	25,000
By act of August 14, 1876	15,000
By act of June 18, 1878	40,000
By act of March 3, 1879	30,000
By act of June, 14, 1880	51,000
By act of March 3, 1881	26,000
By act of August 2, 1882	31,000
By act of July 5, 1884	37,000
Total	265,000

The assignment has been—

For the Warrior	$97,638 38
For Tombigbee below Vienna	95,311 57
For Tombigbee from Fulton to Vienna	72,050 05

Money statement.

Tombigbee River from Fulton to Vienna.

Amount appropriated by act approved July 5, 1884	$10,000 00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	6,087 99
July 1, 1885, amount available	3,912 01
Amount (estimated) required for completion of existing project	27,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	27,000 00

Two thousand dollars of appropriation asked for is for preservation of improvement, Tombigbee above Columbus, now included in this section.

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

Tombigbee River below Vienna.

Amount appropriated by act approved July 5, 1884	$15,000 00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	11,941 83
July 1, 1885, amount available	3,058 17

Amount (estimated) required for completion of existing project	$60,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	60,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

Tombigbee River above Columbus.

July 1, 1884, amount available	$382 57
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	382 57

Included in Tombigbee from Fulton to Vienna.
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

The business done on the Warrior River for the past year has been ascertained for two items only:

5,333 bales cotton, valued at	$266,650
23,600 sacks cotton-seed, valued at	17,700
Estimated value general merchandise	100,000
	384,350

Business on the Warrior has been decreasing of late years, and the amount now done is furnished almost exclusively by plantations immediately on the river.

TOMBIGBEE RIVER.

47,670 bales of cotton, valued at $50	$2,383,500
6,000 barrels turpentine, at $15	90,000
30,000 barrels rosin, at $2	60,000
General merchandise, estimated value	1,250,000
Total	3,783,500

The above is for the Tombigbee business done with Mobile, and does not include timber, lumber, and staves. These are items of considerable importance, but the amount could not be ascertained.

In regard to local business done between Vienna and Fulton, Guttman & Co., merchants of Aberdeen, report:

"We have received between 800 and 1,000 bales of cotton by river. * * * As to the value of merchandise shipped and received, think it will approximate $20,000. Not more than five or six trips made by boat during the season, for the reason that the river has not been so low for twenty years during the usual boating season. We had no river to speak of during the whole winter. We would state that the amount of cotton would have reached at least 6,000 bales had the river been in usual boating order, and, as a natural consequence, shipments of goods to and from points above and below would have been much greater.

"The improvements made on the river have been a great benefit to the town as well as to the people on the river, but there is still a great deal to be done to put the river in navigable condition.

"There has been a stave factory recently erected here and a cotton-seed oil-mill is about to be erected.

"These two new industries will use the river to a great extent in their business.

"The stave factory has built a new steamboat, which, together with one already built, gives us two home-made steamers, both of which expect to ply in the upper river during the coming season.

"The business done at Columbus was cut short, as at Aberdeen, by the low river during the low boating season."

Moore & Cox, grocers, write:

"We hand you items as follows:

Number sacks cotton brought here	25,000
Number bales cotton brought here	1,450

besides a large quantity of general merchandise. Business done by us on river would have been doubled (so reported to us) but for obstructions in Ten Mile Shoals and the bar at Pickensville.

"We should not forget to say that to the navigation of the Bigbee we are indebted for 'river rates' by rail at a time of year when four-fifths of our business is done."

Q 3.

IMPROVEMENT OF BLACK WARRIOR RIVER, ALABAMA, FROM TUSCALOOSA TO DANIEL'S CREEK.

The survey of the Black Warrior River from Tuscaloosa to Sypsey Fork was made in compliance with the provisions of the act of Congress approved March 3, 1879, in the fall of 1879.

The report is contained in the Report of the Chief of Engineers, 1881, Part II, page 1218.

The plan of improvement recommended was by the use of locks and dams, at an estimated cost of $1,200,000, and an appropriation of $200,000 was asked for to begin the work with.

The river is at present navigable at high water only, and even then sufficiently dangerous to put a stop to all commerce on the river, although barges have been frequently floated down to Mobile loaded with coal.

The river and harbor act of July 5, 1884, appropriated $50,000 for the improvement of the portion of this river from Tuscaloosa to Daniel's Creek, a section embraced in the survey.

No project for the improvement has been adopted, but a survey whereon to base plans and estimates was ordered.

This survey has been made, and shows that the section for which the appropriation was made can be improved by the use of locks and dams at an estimated cost of $245,786.

The sum of $2,978 was expended during the fiscal year ending June 30, 1885, which completed the survey.

This survey was commenced on 1st of September of the present fiscal year, and the field work concluded in December, and extended from Tuscaloosa to Daniel's Creek.

Should the plans and estimates contained in report of survey be approved, it is proposed to apply the balance, $47,022, available for the fiscal year ending June 30, 1886, in prosecuting the work in accordance with those plans.

The sum of $198,764 can be profitably expended during the fiscal year ending June 30, 1887, which it is thought will complete the improvement.

The object of this improvement is especially for the transportation, in barges of coal from the coal fields. The enormous quantities of coal in the country through which this river flows, and its superiority and accessibility, prove conclusively the importance of the early completion of this improvement, rendering it available for the use of the General Government, the people of the Gulf States, and the steamers of all nations employed in the commerce of the Gulf.

The amount of commerce to be benefited by the completion of this improvement cannot be estimated, but it is conjectured the benefit would more than warrant the outlay.

Money statement.

Amount appropriated by act approved July 5, 1884	$50,000 00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	2,978 00
July 1, 1885, amount available	47,022 00
Amount (estimated) required for completion of existing project	198,764 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	198,764 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

Q 4.

IMPROVEMENT OF OLD TOWN CREEK, MISSISSIPPI.

The examination of this stream provided for by the provisions of section 3 of the river and harbor act of March 3, 1881, was made during the month of October, 1881, and report is contained in Annual Report of Chief of Engineers, Appendix K 29, 1881.

The condition of the creek when examined showed that the obstructions consisted entirely in accumulations of fallen trees, drift, and overhanging timber.

There were no shoals or rapids in the stream, and no artificial obstructions except a bridge 6 miles below City Point.

Prior to the construction of the Mobile and Ohio Railroad, boats ran to Camargo, 16 miles from the mouth, and in 1852 or 1853 a steamer ascended within 2 miles of City Point.

The project recommended and adopted is to obtain a high-water channel for four months in the year—say from December 1 to May 1—from the mouth of the creek to City Point, a distance of 30 miles, the object being to secure the opening of a competing route for the transportation of plantation products and return supplies.

The estimated cost is $10,000. The river and harbor act August 2, 1882, appropriated $3,000 for this improvement, but the appropriation was not made available until March 1, 1883. Owing to continued high water, operations were not begun until July 2, 1883, and were suspended, on account of near exhaustion of funds, during the following September.

The following work was accomplished:

Trees cut and removed from bank	13,016
Logs and stumps removed from bed	853
Drifts and fish-traps removed	6

The result of the work was such as to permit a steamer to make three trips to Camargo, bringing out 800 bales of cotton and 200 sacks of cotton-seed, carrying on her trips up about 20 tons of supplies and farming implements. About 500,000 feet of lumber in logs were floated down the stream to Columbus and Aberdeen.

As no appropriation was made by the last Congress, no work was done during the present fiscal year.

It is proposed to use what sum may be appropriated for the fiscal year ending June 30, 1887, in continuing the removal of obstructions to high-water navigation, working as far up in the direction of City Point as the amount available will permit.

The sum of $7,000 can be profitably expended during the fiscal year ending June 30, 1887, which amount, it is expected, will complete the improvement as projected.

The benefits to commerce that would ensue from the completion of this improvement will be the opening of a water-way competing with the Mobile and Ohio Railroad, thus affording directly a more convenient and accessible route to market, thereby materially decreasing freight charges on cotton and return supplies, as well as indirectly securing the advantages of competition.

It is estimated that about 34,000 bales of cotton now transported by rail will naturally seek this route, and that a saving of $1.50 per bale over railroad freights would follow, thus securing to the community an annual saving of $50,000, and a corresponding reduction on return supplies of 80 per cent. on value of the cotton.

Money statement.

Amount (estimated) required for completion of existing project.....	$7,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	7,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

Q 5.

IMPROVEMENT OF NOXUBEE RIVER, MISSISSIPPI.

The examination of this river provided for by act of Congress approved March 3, 1879, was made during the month of March, 1880, and extended from Macon, Noxubee County, Mississippi, to its mouth.

Report is contained in the Annual Report of the Chief of Engineers for 1880.

The condition of the river when examined was such that during all seasons of the year, and at all stages of water, navigation, except by small flat-boats, was practically impossible.

Steamboats, prior to the building of the Mobile and Ohio Railroad, plied this river (1859). After the construction of this railroad the boats were withdrawn; the river then became overgrown with timber, which in time fell or slid into the river, causing snags and logs to lodge on the river's bottom, and also caused the formation of a number of shoals and bars.

The river being virtually abandoned for the purposes of navigation, the planters living along its banks assisted in closing up its channel-way by building a number of fish-traps and mill-dams.

The chief obstructions to navigation consisted in the immense number of trees overhanging its banks throughout its entire length, in some places being so dense as to roof the river in.

At the time of the examination the depth of the river was found to be (at low water) from 1½ feet to 2 feet, and the average width 60 feet.

The project adopted was to afford a navigable channel for nine months in the year from its mouth to the town of Macon, by the removal of overhanging timber from the banks and such obstructions to navigation as might be found in the river.

The estimated cost was $65,245.25.

The appropriations made for the improvement are as follows:

By act of Congress approved June 14, 1880	$12,000
By act of Congress approved March 3, 1881	8,000
By act of Congress passed August 2, 1882	10,000
By act of Congress approved July 5, 1884	7,500
Total	37,500

Work on this improvement was commenced during the low-water season of 1880, prosecuted during the fiscal years ending June 30, 1881, and June 30, 1882, and through the month of March, 1883, when, the appropriation being about exhausted, operations were suspended.

Under the appropriation of $7,500, made by act July 5, 1884, work was resumed in September of the present fiscal year. Two quarter-boats were built, tools, implements, &c., purchased during this month, and on October 1 work on the river began at a point 1½ miles below Macon. Operations were continuously prosecuted until the 12th of the following January, when high water and extreme cold weather compelled a suspension of the work. The boat and property were carried down the river and moored at Gainesville, on the Tombigbee River.

About 28 miles of the upper section of the river was thoroughly improved, all obstructions removed, and overhanging timber cut.

On May 23 operations were again resumed at the mouth, and were continued without interruption to the close of the fiscal year.

Twelve miles of this portion of the river were wholly improved.

The amount of work done during the present fiscal year is itemized as follows:

Quarter-boats and skiffs built	2
Trees felled, cut up, and pulled back	1,325
Stumps cut to within 1 foot of low water	7,299
Overhanging limbs cut	1,888
Stumps blasted	185
Snags and logs removed from the bed of the river	1,616
Drifts removed	2

The river has been partially improved from Macon to its mouth, and wholly from Macon to a point 28 miles below, and from the mouth for 12 miles above, giving a river 40 miles wholly improved and 51½ miles partially.

The river is navigable during high water from Macon to its mouth, not with safety, however; a raft having formed during the suspension of work at the "cut-off," about 30 miles above the mouth, which is a serious obstruction to safe navigation.

It is proposed to apply the funds available during the fiscal year ending June 30, 1886, to continuance of the removal of obstructions to high-water navigation, working up-stream as far as the balance on hand will permit.

It is expected that the proposed expenditure of this money will result in a wholly improved channel from the mouth to the cut-off—30 miles.

Should funds allow, work will also be commenced on removal of the "raft" above mentioned.

The sum of $25,000 can be profitably expended during the fiscal year ending June 30, 1887, in continuing the improvement by widening and deepening the channel, removing the snags and logs which from time to time will find their way into the river, removing overhanging timber from the banks, and in clearing away the "raft" at the "cut-off."

On completing the improvement as designed, the river during high-water season will be navigable from its mouth to Macon; thus furnishing a new and cheaper transportation route for the planters residing along or adjacent to the river for their cotton produce and supplies, the greater portion of which is now hauled over heavy prairie roads from long distances to the different stations on the Mobile and Ohio Railroad.

The work is not susceptible of permanent improvement, and will require an annual expenditure of at least $3,000 to maintain it in its improved condition.

The commerce taking advantage of the improved condition of the river during the present fiscal year could be ascertained only for the following items: 500 bales of cotton, 50 tons cotton seed, 60 cords firewood, 5,000 staves, down-stream, and 30 tons general merchandise return freight.

The estimated value of the shipments over the river when improvement is completed is about as follows:

16,000 bales of cotton	$880,000
Cotton-seed, corn, oats, and other products	100,000
Return merchandise and plantation supplies	784,000
Total	1,764,000

The reductions in freight charges on cotton and produce that will naturally follow the opening of this river for navigation is estimated at least $20,000 per annum.

A corresponding decrease in the freight charges will also be felt in all lines of goods and merchandise transported, owing to the discrimination made between through and local rates by railroads.

The shipments over the river may possibly be also increased by the improvement furnishing the means of supplying coal to the inhabitants living near the river from the coal fields of the Sipsey and Warrior rivers.

Money statement.

July 1, 1884, amount available	$617 91
Amount appropriated by act approved July 5, 1884	7,500 00
	8,117 91
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	4,732 51
July 1, 1885, amount available	3,385 40
Amount (estimated) required for completion of existing project	25,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	25,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

Q 6.

IMPROVEMENT OF PASCAGOULA RIVER, MISSISSIPPI.

In 1873 a plan for the improvement of the river at its mouth, by dredging a channel 200 feet wide and 7 feet deep at mean low water, was submitted by Lieut. James B. Quinn, Corps of Engineers, but owing to legal complications, as to the ownership of what was then known as the "Noyes Canal," nothing was done under the plans and specifications then submitted.

In 1878, all fear of legal complications having been removed, an examination of the river was made, under an appropriation, by act of June 18, 1878, of $10,000 for the improvement, $1,500 being allotted for the examination.

The plan adopted was the dredging of a channel 200 feet wide, 7 feet deep at mean low water, through the bar at the mouth of the river and the removal of snags and overhanging trees throughout its entire length, at an estimated cost of $66,000.

At the commencement of the work there were from 3 feet to 3½ feet on the bar at mean low water, and the river was much obstructed by snags, logs, and overhanging trees.

The following appropriations have been made:

By act June 18, 1878 ($1,500 for examination)	$10,000
By act March 3, 1879	14,000
By act June 14, 1880	20,000
By act March 3, 1881	4,000
By act August 2, 1882	8,000
By act July 5, 1884	3,000
Total	59,000

Dredging operations, under contract with S. N. Kimball, were commenced July 18, 1880, $8,500 of the first appropriation ($1,500 having

been used on the survey) and the whole of the second ($14,000) being available for this purpose.

Funds were exhausted in January, 1881, and work suspended.

Work under this contract gave a channel through the bar 1 mile in length, 75 feet wide, and 7 feet deep.

Under the appropriation of $20,000, made by act June 14, 1880, dredging was resumed, W. G. Mitchell, of New Orleans, La., being the contractor, in March, 1881, and was concluded in March, 1882.

This completed the adopted project so far as related to the improvement of the bar at the mouth, securing a channel 180 to 190 feet wide, 7½ to 8 feet deep, and enabling vessels to go up to the mills at Moss Point and load, thus saving large lighterage bills and claims for demurrage.

During the spring of 1882 a log-boat, with steam capstan, was built in Mobile, towed over to the mouth of the Pascagoula River, and in June of the same year the removal of snags, logs, and overhanging trees was commenced.

At the close of the fiscal year ending June 30, 1883, the river was partially improved from the mouth to "Dead Lake," a distance of 50 miles.

The improvement during the fiscal year ending June 30, 1884, consisted in reworking the portion of the river already partially improved, and resulted in securing a navigable stream for vessels drawing 6½ feet from the light-house to half a mile above Dead Lake, 50½ miles.

Under the appropriation, $3,000, made by act July 5, 1884, and a small balance remaining from the previous appropriation, operations were resumed in September of the present fiscal year and continued until December 23.

The point selected for resumption of work was at Cumbest Landing, 15 miles below Dead Lake, and was prosecuted up-stream.

The stretch of river between Cumbest and Dead Lake had been partially improved and required but little rework during the present year to place it in the condition proposed by the plan of improvement.

Starting from Dead Lake the new work was prosecuted to the junction of the Leaf and Chickasaha, reaching this point on 5th of November, the distance from the light-house near the mouth being 109 miles.

As the stage of the water was very favorable for removing obstructions from the bed of the river, and the amount available for expenditure being small, the work during the year consisted principally in the removal of logs and stumps from the channel. No bank work was attempted, it being thought that no such low water would occur again in several years and funds on hand not permitting the employment of more than one working party.

Seventy-three and one-half miles of the river has been worked during the present year, 15 miles reworked and wholly improved, and 58½ miles new work and only partially improved.

The following is a summary of the work accomplished during the year:

* * * * * * *

Time worked during the year, three months and eight days.

Number miles reworked and wholly improved	15
Number miles new work and partially improved	58½
Number snags removed from bed of river	1,115
Number stumps blasted from bed of river	36
Number trees felled, cut up, and pulled back	517

The result of this work, together with that of previous years, has been to secure a navigable channel from the mouth of the river to

one-half mile above Dead Lake, 50½ miles, for vessels drawing 6½ feet, and to the junction of the Leaf and Chickasaha for vessels of lighter draught, during six or eight months of the year.

It is proposed to expend such funds as may be appropriated for the fiscal year ending June 30, 1887, in continuing the work of improvement as heretofore prosecuted, removing such logs, &c., from the river from Moss Point to Dead Lake as may have lodged during the suspension of work, and reworking that portion between Dead Lake and the junction, partially improved during this fiscal year.

Since the beginning of the work of improvement large sales of Government and State lands have been made to capitalists adjacent to the river, and the continuance of the work will offer further inducements for investments for development of the resources of this richly timbered section.

The sum of $7,000 can be profitably expended during the fiscal year ending June 30, 1887, which, it is thought, will complete the improvement as projected.

This improvement will not be permanent in its character, but will require an annual appropriation for the maintenance of its improved condition; exactly what sum will be needed cannot be as yet accurately estimated, but judging from present indications a small amount compared to its original cost will be required.

The improvement even in its incomplete state has already been of vast benefit to the country depending for its trade upon the navigation of this river; the shipments of lumber alone have increased in an immense degree; turpentine orchards have been established; real estate at Moss Point and Scranton has advanced 50 per cent. in value, all owing to the improved condition of the river.

Money statement.

July 1, 1884, amount available	$276 08
Amount appropriated by act approved July 5, 1884	3,000 00
	3,276 08
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	2,706 92
July 1, 1885, amount available	569 16
Amount (estimated) required for completion of existing project	7,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	7,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

Q 7.

IMPROVEMENT OF ROADSTEAD THAT LEADS INTO THE BACK BAY OF BILOXI, MISSISSIPPI.

The examination of this roadstead, provided for by third section of river and harbor act of March 3, 1881, was made during the months of August and September, 1881. The report is contained in the Annual Report Chief of Engineers, 1882, Appendix K 27.

The examination showed that between the roadstead and the back bay are situated a series of mud-flats, called "Deer Island Flats," distant about 1¼ miles east of Biloxi, having a present depth of 4 feet.

The result desired to be secured is the dredging of a channel 8 feet deep, at an estimated cost of $35,000.

An appropriation of $5,000 for the improvement of this roadstead was made by act of Congress passed August 2, 1882.

No project has been submitted, the amount appropriated being deemed insufficient for an economical prosecution of the work. Authority was therefore obtained, under date September 25, 1882, to defer all action until a further appropriation was made.

The river and harbor act July 5, 1884, directed that the balance of the money heretofore appropriated for the roadstead, now on hand, be applied to the deepening of the channel from Mississippi Sound to the wharves of Biloxi.

The examination of this locality was made during the months of August and September, 1882, and report is contained in Annual Report Chief of Engineers, 1882, Appendix K 27.

The improvement desired is the deepening of the channel from Mississippi Sound to the wharves at Biloxi from 4½ feet, the least depth at present, to 8 feet at mean low water.

The improvement can be accomplished by dredging, and a channel 150 feet wide and 8 feet deep at mean low water obtained for about $55,000.

Authority was obtained, under date August 27, 1884, to hold the appropriation until a further one is made sufficient to permit an economical prosecution of the work contemplated. No project was therefore submitted.

No work has been attempted, nor is any proposed, until further appropriations are made.

Such sum as Congress may appropriate for expenditure during the fiscal year ending June 30, 1886, together with amount now on hand, will be applied to deepening the channel, as proposed, from 4½ feet to 8 feet.

The sum of $50,000 can be profitably expended during the next fiscal year, which would probably secure the relief desired. The improvement, it is thought, cannot be made permanent.

The increase to commerce likely to ensue from the completion of this improvement would be difficult to estimate at present, but it is safe to say that it would be largely in excess of the amount estimated for the prosecution of the work.

Biloxi is in the Shieldsborough collection district, and nearest light-house is at Biloxi Bar.

Money statement.

July 1, 1884, amount available	$4,988 55
July 1, 1885, amount available	4,988 55
Amount (estimated) required for completion of existing project	50,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	50,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

Q 8.

IMPROVEMENT OF HORN ISLAND PASS, MISSISSIPPI.

The examination of this locality was made during the months of August and September, 1881, and report is contained in Annual Report Chief of Engineers, 1882, Appendix K 28.

This pass is the nearest outlet to sea for all vessels loading at Pascagoula, and the object desired is to obtain 21 to 22 feet depth through this pass at mean low water, thus enabling vessels drawing more than

17 to 18 feet to complete their loads near Pascagoula, saving the cost of a long, expensive, and dangerous tow, 25 miles, to Ship Island, where they are now obliged to load.

The proposed improvement of the pass would allow them to load within 9 miles of their principal market.

The present depth of the pass is 16½ feet at mean low water.

The improvement can be made by dredging, and the estimated cost for a channel 100 feet wide, 21 feet deep, is $43,000.

An appropriation of $5,000 was made by the river and harbor act of July 5, 1884, for the improvement of this pass.

No project was submitted, as the amount was deemed inadequate to an economical prosecution of the work. Authority was therefore obtained to hold this appropriation until one sufficient for economical work has been made.

Nothing has therefore been done during the present fiscal year, nor will anything be attempted until further appropriations are made.

Should Congress during its next session make a further appropriation for expenditure during the fiscal year ending June 30, 1887, that sum, with amount now on hand, will be applied to deepening the channel of the pass to 21 feet.

The sum of $38,000, exclusive of the amount, $5,000, now on hand, can be profitably expended during the fiscal year ending June 30, 1887, which it is thought will secure the relief desired.

The improvement when completed will probably be reasonably permanent, as the pass appears to be slowly deepening from year to year from natural causes.

The commerce to be benefited is about as follows:

Vessels cleared for foreign countries	136
Vessels cleared coastwise	43
Total	179
Tonnage of foreign clearances	68,425
Tonnage of coastwise clearances	14,615
Total	82,040

EXPORTS.

Foreign:	
38,655,542 superficial feet lumber	$516,916 00
1,997,848 cubic feet lumber	87,052 00
Total	603,968 00
Coastwise:	
6,741,208 superficial feet lumber, valued at	53,929 06
Foreign	603,968 00
Coastwise	53,929 06
Total value of exports	657,897 06

Money statement.

Amount appropriated by act approved July 5, 1884	$5,000 00
July 1, 1885, amount available	5,000 00
Amount (estimated) required for completion of existing project	38,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	38,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1887.

Q 9.

IMPROVEMENT OF PEARL RIVER, MISSISSIPPI, BELOW JACKSON.

A survey of this part of the river was made under direction of Capt. C. W. Howell, Corps of Engineers, U. S. A., during the months of March and April, 1879.

By act of Congress, approved June 14, 1880, an appropriation of $30,000 was made for this work.

After due advertisement a contract was entered into October 7, 1880, with S. N. Kimball, for the improvement of 195 miles of this river from Jackson down.

Owing to high water the contractor was unable to complete his work within the time specified, January 1, 1882, and an application for extension of time to Jannary 1, 1883, was approved.

By act of Congress approved March 3, 1881, a further appropriation of $25,000 was made, and a project for the expenditure of this amount was submitted and approved.

After due advertisement a contract was entered into with G. A. Meyers for the improvement of 100 miles more of the river, commencing at a point 195 miles below Jackson, the end of Kimball's work.

On July 27, 1882, the work was reported finished, but an inspection showed that it was not in accordance with specifications, and the contractor resumed work. August 23, 1882, the work was accepted.

Fifty-three thousand seven hundred and ninety-six dollars have been applied to the clearing out of 295 miles of river; there remained from 15 to 20 miles of bad river near the mouth, upon which no work had been done.

A number of shoals in the reaches under contract remained also, the improvement of which were not included in the contracts.

August 2, 1882, a further appropriation of $15,000 was made for this work, to be expended under the supervision of the United States Engineer Office by hired labor. In November, 1883, the work was for various reasons suspended. A watchman was placed on the plant to take care of the property.

The work accomplished by hired labor was the closure of twelve run-out bayous by levees and pilings, the cutting of 120 snags, and the girdling of 709 trees on the banks.

By act of Congress approved July 5, 1884, the sum of $10,000 was appropriated for the continuation of the work by hired labor.

The original project for improving this part of the river was adopted in 1880, the object being to obtain a navigable channel 5 feet deep at low water from Jackson down to the mouth by the removal of snags, stumps, roots, and sunken trees out of the river-bed, and the clearing of banks of overhanging trees, at an estimated cost of $95,940.

When the survey of this part of the river was made, during the months of March and April, 1879, th- stage of water was, according to the official report of Mr. H. C. Collins, the assistant engineer in charge, 10 feet above low water, which is considered good boating river. The estimate of the cost of improving this part of the river was based on the report of Mr. Collins.

The entire distance, 295 miles, where contract work was done requires to be worked over again in low water, in order to obtain the desired low-water channel contemplated in the original plan of improvement.

During a late inspection of the river from Jackson to the mouth, in November, 1884, the river was at a very low stage. The inspection was

made in a skiff, two men pulling, and consumed eleven days. The party were obliged to cut their way through almost every mile of the route, and had to haul and lift the skiffs over logs and trees, rocks, shoals, and gravel and sand-bars at over one hundred different places.

The log obstructions were not of recent formation, but showed plainly the old cuts of axes and saws of the contract work, many of the snags and trees cut off projecting from 6 to 8 feet above the water, making the obstructions more dangerous to navigation than they were before they were touched.

It does not seem possible that a clear 5-foot channel at low water could have been obtained by the contractor, except in a few reaches where the banks are rock walls where the river is deep, and but little if any work was required.

The original estimate of this work was $95,940. Of this amount $53,736 has been expended in contract work without any great benefit or relief to navigation.

Twenty-five thousand eight hundred and seventy-three dollars and sixty-seven cents was expended by hired labor and purchase of material under direction of Maj. Amos Stickney, Corps of Engineers, U. S. Army, in the closure of runout bayous and cut-offs, the removal of some snags, and the girdling of a number of trees on the banks below the head of West Pearl River. A balance of $16,290.33 remained on hand for expenditure during the fiscal year ending June 30, 1885.

The original estimate of $95,940 for the improvement of the river from Jackson to the mouth, a distance of 3.15 miles, as contemplated by the original plan, is, in my opinion, altogether inadequate, even had the contract work been done according to specifications.

The present commerce on this part of the river does not require a clear 5-foot channel at low water.

If the river is improved so as to give a 2-foot channel at low water navigation during about eight months of the year will be secured.

This can be accomplished by the removal of snags, sunken logs, and trees, and the clearing of the banks from overhanging trees, at an estimated cost, exclusive of the amounts already appropriated, of $50,000.

If, however, the original plan of improvement should be adhered to, and a clear 5-foot channel at low water is desired, it will require, in addition to the removal of snags, logs, &c., the construction of wing-dams and the removal of rock and gravel bars, at an estimate cost, exclusive of the amounts already appropriated, of $100,000.

In accordance with instructions from the Chief of Engineers, United States Army, dated Washington, D. C., July 8, 1884, this work was transferred by Maj. Amos Stickney, Corps of Engineers, U. S. Army, to Maj. A. N. Damrell, Corps of Engineers, U. S. Army.

The sum of $5,154.83 was transferred by Major Stickney.

Ten thousand dollars, appropriated by act of Congress approved July 5, 1884, was also available, making a total on hand at the transfer of $15,154.83.

Up to December 1, 1884, operations on this part of the river were suspended; a watchman was employed taking care of the plant and property.

The head of West Pearl River is located about 263 miles below Jackson.

From the head of West Pearl River that part of the river known as East Pearl River runs east for a mile and then south through Homes Bayou. It re-enters West Pearl about 20 miles from the head. This part of East Pearl is the only navigable channel that can be used.

West Pearl, from the head down, for a distance of 14 miles, although there is plenty of water is nothing but a cypress swamp; no channel exists and navigation is impossible.

Two-thirds of the volume of water enters the head of West Pearl, and is lost for a distance of 20 miles, while comparatively a very small portion of water enters East Pearl, diminishing its current and forming sandbars and shoals.

Owing to the low banks, both above and below the head of West Pearl, as also to the great depth, nearly 50 feet at the head, it would be very difficult to close it up there effectually, as at almost every freshet the strong current would cut its way through, either above or below, and the shoaling process in East Pearl would continue and no relief to navigation be given.

If this process of shoaling should be permitted to continue there is no doubt but East Pearl would finally close up altogether. West Pearl cannot be used for navigation, and navigation on the river would be practically stopped.

Three-fourths mile above the head of West Pearl there is a narrow strip of land 800 feet wide. Across this strip a narrow bayou has washed out, but is choked up by drift.

The only practical way of keeping navigation through East Pearl open seemed to be to open a cut-off through this strip of land above the head of West Pearl into East Pearl deep enough to take the water even during a low stage of river, and wide enough to allow steamboats and other craft to pass up and down. By opening this cut-off the main river enters East Pearl three-fourths of a mile above West Pearl, and through the cut-off into East Pearl three-fourths of a mile below West Pearl, cutting off 1½ miles of river. The advantages that may be gained by the opening of this cut-off can easily be perceived. Work on the opening of this cut-off was commenced December 1, 1884, and continued whenever the stage of water permitted working to advantage.

Over one-half of the volume of water of the main river now runs through the cut-off, and as the deepening progresses nearly all the water will pass through, taking it away from West Pearl and forcing it into East Pearl.

A heavy drift of logs and trees have been placed and secured across the head of West Pearl, and several hundred large trees have been felled into the river below the drift, so as to lessen the current and cause sand-bars to form.

Since the opening of the cut-off commenced the shoals and sand-bars that had formed between the cut off and Wakiah Bluff, one-half mile below, and which were very troublesome to steamboats, have deepened 16 inches, and are still deepening, and it is expected that by the increased volume of water and current the original depth through this part of East Pearl River will be restored, and boats will have no trouble there.

The summary of work performed during the fiscal year ending June 30, 1885, is as follows:

Number of stumps removed	1,398
Number of roots removed	4,749
Number of logs removed	1,379
Number of knees removed	42
Number of standing trees removed	1,454
Number of overhanging trees removed	411
Number of cubic yards sand and clay removed	7,359½

A large amount of drift was removed, and a great deal of cane cut from the banks.

The condition of the improvement of this part of the river on the 30th

of June, 1885, has not materially changed or improved, owing to the fact that work on removing snags and trees was only commenced, with the derrick-boat, during the latter part of June.

Most of the work was confined to the opening and deepening of the cut-off.

Nearly all stumps, roots, and logs have been removed, and the sand and clay has been dug and wheeled out to a level of 14 inches above low water.

A strong current runs through now, and with some more digging and the scouring action of the current it is expected that this cut-off will be used altogether by boats during the next boating season.

The condition of the river above the cut-off, as far as Jackson, Miss., is about the same as when left by the contractors, and can be navigated safely only on a 6 or 7 foot rise.

The river below the cut-off down to its mouth, with the exception of Homes Bayou, is in a better condition.

A number of sand bars and shoals have formed within the last five years, but it is reasonable to expect that with the increased volume of water and current due to the opening of the cut-off above these bars and shoals will improve materially.

Nearly all the jetties and dams constructed, and piles driven heretofore, across a number of runout bayous between the head of West Pearl, Pearl River, and Homes Bayou, have been damaged.

Homes Bayou, connecting East and West Pearl rivers, and used altogether by boats navigating this river, is a narrow and very crooked bayou 5½ miles long, greatly obstructed by stumps, fallen and overhanging trees.

As operations in this bayou were only commenced during the latter part of June, 1885, the improvements made so far give but little aid to navigation.

It is proposed to apply the funds available for expenditure during the fiscal year ending June 30, 1886, $8,386.01, to the completion of the cut-off three-fourths of a mile above the head of West Pearl, so that boats of 5 feet draught of water can pass through at a low stage of the river; to the removal of snags, stumps, roots, and trees in the bed of Homes Bayou; to the clearing of the banks of overhanging and standing trees and cane; to the closing up, by drift, gravel, and willows, of Fair Slough, situated 7 miles below Wakiah Bluff and 7½ miles above the upper end of Homes Bayou; to the closing up, with the same kind of material, of Little Homes Bayou, situated 2½ miles below the upper end of Homes Bayou. After completion of these works it is proposed to commence operations, with one boat, on the removal of obstructions to navigation, such as were left by the contractors, and such as have formed since the closing of the contracts from the head of Homes Bayou up-stream towards Jackson, Miss.

With the other boat it is proposed to work down-stream from the lower end of Homes Bayou towards the mouth.

The benefits that may be expected by the expenditure of this money for the purpose mentioned are as follows: Greater security to navigation between New Orleans, La., and Jackson, Miss., and reduced freights on merchandise and produce. The greater portion of the cotton, merchandise, &c., are now hauled from Georgetown, Columbia, Monticello, and other towns located on the river, to the nearest railroad stations on the Illinois Central and Northeastern railroads, a distance of from 20 to 40 miles.

Freight on a bale of cotton shipped in this way to New Orleans, La.,

costs now $4.80, a barrel of flour shipped in this way from New Orleans to Columbia or Monticello, $2.

Freight on a bale of cotton shipped down the river by boats, delivered at New Orleans, costs $1.50, a barrel of flour 60 cents, other freights in proportion.

This shows there would be a very large reduction and saving in freights by river competition by the improvement of the river.

The estimated amount required, exclusive of appropriations already made, for the completion of the original project of improvement is $100,000.

By modifying the original project, however, so as to obtain a 2-foot channel at low water, which is really all that the present commerce demands, $50,000 exclusive of appropriations already made will be sufficient.

In addition to the improvement of the river proper, the increased lumber trade of the mills situated on the river, particularly that of Messrs. Poitevant & Faroe, at Pearlington, Miss., located about 12 miles above the mouth of East Pearl River, demands the deepening of the bar at the mouth by dredging.

Vessels of 7-foot draught of water can be loaded at the mills on the river, but the lumber for vessels of heavier draught, of which there are a large number loaded by the mills, must now be lightered and towed over the bar, which not only causes great delay, but heavy expense.

It is desired by mill-owners and those interested in the lumber business on the river to obtain a 12-foot channel over the bar. After vessels cross the bar there is sufficient water up to the mills to load down to 12 feet.

The estimated cost of dredging a channel 12 feet deep at mean low tide over the bar at the mouth of East Pearl River is $20,000.

Owing to the caving in of banks after freshets, as also to the shifting of the channel, the improvements so far made and contemplated will not be permanent.

An annual appropriation of $4,000 would be sufficient to maintain the river in the condition contemplated by the plan of improvement.

Money statement.

July 1, 1884, amount available	$6,290 33
Amount appropriated by act approved July 5, 1884	10,000 00
	16,290 33
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	7,910 32
July 1, 1885, amount available	8,380 01
Amount (estimated) required for completion of existing project	100,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	70,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

Number of vessels entered and cleared and loaded, Pearl River, Mississippi.

Character of vessels.	American.	Foreign.	Tonnage.
Ships	1	2	3,100
Barks		4	3,700
Brigs	1	4	2,270
Schooners	6	10	4,017
Total	8	20	13,087

Number of vessels employed lightering lumber from Pearl River.

Character of vessels.	Number.	Tonnage.
Steamers	2	97
Schooners	14	465
Barges	1	55
Total	17	617

Statement of lumber shipped from Pearl River.

Direction.	Superficial feet.
Shipped to exportation	15,000,000
Shipped to dealers	16,000,000
Shipped to foreign and coastwise	10,000,000
Total	41,000,000

Imports via Pearl River.

Articles.	Tons.
Mahogany and cedar	450
Hemp	100
Total	550

Statement of vessels employed on Upper Pearl River.

Character of vessels.	Number.	Tonnage.
Steamers	4	222

Statement of staple articles transported on Pearl River to and from New Orleans, La., and to saw-mills near mouth.

DOWN-STREAM.

Articles.		Number.
Cotton	bales..	3,000
Rice	barrels..	100
Staves	number..	10,000
Firewood	cords..	2,500
Sawlogs	number..	200,000
Square timber	cubic feet..	50,000

UP-STREAM.

Articles.		Number.
Fertilizers	tons..	300
Grain	do...	250
Machinery, &c	do...	100
General merchandise	do...	500
Total		1,150

Statement of staple articles transported on Pearl River for preceding year 1883–1884.

DOWN-STREAM.

Articles.	Number.
Cotton ..... bales..	2,000
Saw-logs ..... number..	50,000

UP-STREAM.

Articles.	Number.
General merchandise ..... tons..	180

Q 10.

IMPROVEMENT OF PEARL RIVER, MISSISSIPPI, FROM JACKSON TO CARTHAGE.

An examination of this part of the river was made, under direction of Capt. C. W. Howell, Corps of Engineers, U. S. Army, in 1879.

By the river and harbor act of March 3, 1879, the sum of $6,000 was appropriated, and on November 20, 1879, a contract was entered into with J. S. Hamilton & Co. for the improvement of this part of the river.

On June 14, 1880, another appropriation of $7,500 was made, and on October 12, 1880, another contract was made with J. S. Hamilton to continue the work.

An appropriation of $2,500 was made March 3, 1881, but after due advertisement no bids were received for work under this appropriation, and the amount was allowed to stand, awaiting further appropriations sufficient to warrant commencement of work.

August 2, 1882, an additional appropriation of $2,500 was made. On July 1, 1883, there was available for this work the sum of $17,800.76, and on the 17th of August, 1882, a project was submitted to continue the work by hired labor, which was approved.

The work under the Hamilton contracts did not prove satisfactory, and the contracts were annulled September 22, 1882.

There was expended during the fiscal year ending June 30, 1884, $10,993.34.

The original project for the improvement of this part of the river consisted in the removal of snags, logs, and overhanging trees, and was to afford a clear channel of navigation 5 feet deep at a low stage of the river from Jackson to Carthage, a distance of 105 miles, at an estimated cost of $21,000. This amount is, however, in my opinion, not sufficient to clear the river of obstructions so as to give safe navigation during a low stage of water.

The original estimate should be increased to $50,000.

The former method of improvement was the removal of obstructions from the channel and clearing of the banks from overhanging trees by contract.

As, however, the contract work did not prove satisfactory, and both of the contracts with J. S. Hamilton were annulled, the original plan of improvement was modified in so far as to continue the improvement by hired labor and purchase of material.

On July 8, 1884, the work was, in accordance with instructions from the office of the Chief of Engineers, United States Army, transferred by Maj. Amos Stickney to Maj. A. N. Damrell, and the improvement

was carried continuously down-stream to a point 12 miles below McFadden's Ferry, at Carthage.

The improvement of this part of the river is not permanent, but will have to be worked over again from time to time, owing to the caving in of the banks and the shifting of the channel.

In the balance of the river down to Jackson, 93 miles, only the worst and most dangerous places were partly improved. The entire distance requires working over again.

In January, 1885, the appropriation being exhausted, the derrick and quarter-boats were carried down-stream below Jackson to Wakiah Bluff, the boats and machinery overhauled and laid up, to be used on the improvement of the river below Jackson.

During the progress of the improvement there were removed 6,686 snags, roots, and logs; 320 stumps; 312 sunken trees; 3,494 cypress knees; 6,851 overhanging trees, and 700 yards of bank were protected with brush and willows.

On the 30th of June, 1885, the condition of the river was as follows: 12 miles from Carthage down boats of 3 feet draught of water can navigate with comparative safety at a stage of river 4 feet above low water. In the other part of the river down to Jackson boats can navigate on a 6-foot rise above low water.

Before the improvement, even during high water, steamers could not make more than two trips a month between Jackson and Carthage. Since the improvements boats make four and five trips a month.

It is proposed to apply the small balance on hand June 30, 1885, $52.40, in payment of current office expenses, as the amount is too small to do any work on the river.

The sum of $10,000 can be profitably expended during the fiscal year ending June 30, 1887, in the removal of snags, stumps, roots, and logs from the channel and overhanging trees from the banks, giving a greater security to navigation by the deepening of the channel, by the washing away of sand and gravel bars, by the removal of sunken logs and trees. It is believed additional boats would be placed on the river and that commerce would increase materially.

The estimated amount required for the completion of the original project for improving this part of the river is $31,500.

Owing to the continual caving of the banks and shifting of the channel, the improvement will not be permanent.

An annual expenditure of $2,400 would maintain the river in the condition contemplated by the plan of improvement.

As there was only one steamer, the O. R. Singleton, navigating between Jackson and Edinburg, making Carthage only a way landing, the commercial statistics for this part of the river are the same as for that portion between Edinburg and Carthage.

The work is located in the collection district of New Orleans, La. The nearest light-house is on the Rigolets, opposite the mouth of West Pearl River. The nearest forts are Forts Pike and Macomb, located in the Rigolets, near the light-house.

Money statement.

July 1, 1884, amount available	$6,807 42
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	6,755 02
July 1, 1885, amount available	52 40
Amount (estimated) required for completion of existing project	31,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	10,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

Q 11.

IMPROVEMENT OF PEARL RIVER, MISSISSIPPI, BETWEEN EDINBURG AND CARTHAGE.

This portion of Pearl River is entirely in Leake County, Mississippi, beginning almost on the line of Neshoba County, and goes through Leake County in a southwesterly direction, forming the boundary between Madison and Franklin counties.

There is no navigable channel in the greater portion of this part of the river during low water. Although high banks are found on both sides of the river, yet the river is so obstructed by fallen trees, snags, roots, logs, standing trees, sand and mud bars that navigation by the steamer O. R. Singleton, built for this trade in 1883, was only possible during very high water.

Under an allotment of $2,500 made by the river and harbor act of July 5, 1884, work on this part of the river was commenced at Edinburg on the 17th of November, 1884, and continued until the 23d of January, 1885, when, the river becoming too high for working to advantage, operations were suspended.

The original project for the improvement of this part of the river is to afford a high-water channel from Edinburg to Carthage, a distance of 24¾ miles, for six or eight months of the year, at an estimated cost of $13,464.

The method of improvement is the removal of obstructions from the channel and clearing of the banks of overhanging trees by hired labor and purchase of material.

Two flat-boats and two skiffs were constructed, the necessary outfit was purchased, and the river was partially improved for a distance of 17 miles from Edinburg down, but will have to be worked over again, leaving 7¾ miles yet on which nothing has been done.

During the progress of the improvement there were removed—

Snags, logs, and stumps	400
Trees from the channel	368
Overhanging trees	680
Fallen trees	94
Yards of bank cleared of brush	6,491

On the 30th of June, 1885, the condition of the improvement was such as to allow boats of 3½ feet draught of water to navigate the 17 miles of river improved during the season, with comparative safety on a rise of 6 feet above medium low water.

Considerable benefit was derived from the work already done, as shown by the fact that before the improvement the time consumed by the steamer ascending the river from Carthage to Edinburg averaged six days, while after the partial improvement the steamer made several trips from Carthage to Edinburg in fourteen hours.

It is proposed to apply the small balance on hand June 30, 1885, ($389.61), to the removal, by blasting, of stumps, roots, and logs as far as the amount will permit.

The sum of $10,964 can be profitably expended during the fiscal year ending June 30, 1887, in removal of sunken logs and trees, stumps, roots, trees standing in the channel, and trees overhanging from the banks, which would probably so improve the river that boats would be enabled to run during a stage of the river 6 feet above low water with comparative safety.

It is believed that additional boats would then be placed on the river, and no doubt the commerce would materially increase.

The estimated amount required for the completion of the original project for improving this part of the river is $10,964.

Owing to the continual washing of banks causing trees to fall in, and the continual shifting of the channel, the improvement will not be permanent.

It is estimated that an annual appropriation of $500 would maintain the river in the condition contemplated by the plan of improvement.

Before the improvement most of the merchandise had to be hauled by wagons between Edinburg and railroad stations, a distance of from 40 to 60 miles.

The reduction and saving in railroad freights, by river competition, due to improvement, is considerable, as shown by the following exhibit:

Freight on a barrel of flour from Mobile, Meridian, or New Orleans, delivered at Edinburg, was before the improvement $2.10; now it is 60 cents. This saving in freight on a ton of fertilizer is $5; on a bale of cotton, $4.

It is estimated that the aggregate annual saving in freights to the farming interest of the county adjoining the river, due to the improvement, will not fall short of $30,000.

Money statement.

Amount appropriated by act approved July 5, 1884	$2,500 00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	2,110 39
July 1, 1885, amount available	389 61
Amount (estimated) required for completion of existing project	10,964 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	10,964 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

The following is a tabulated statement of the aggregate amount of the staple articles transported on the river:

	Tons.
Flour	50
Bacon	10
Guano	400
Grain	150
Machinery, &c	60
General merchandise	130
Total	800

Down trips:		
Cotton	bales	1,900
Wool	do	58
Staves	number	8,000
Lumber	feet	25,000
Saw-logs	number	10,000

The following is a statement of the aggregate amount of staple articles transported on the river for the year preceding the commencement of the improvement.

Up-stream:	Tons.
Flour	10
Bacon	5
Guano	60
Grain	20
Machinery, &c	—
General merchandise	100
Total	195

Down-stream:		Tons.
Cotton	bales..	380
Wool	do..	20
Staves	do..	2,000

Only one boat, the steamer O. R. Singleton, has been employed on this part of the river during the fiscal year. Her dimensions are: Length, 95 feet; tonnage, 110 feet; draught of water, 4½ feet.

Q 12.

PRELIMINARY EXAMINATION OF HOMOSASSA BAY, FLORIDA.

UNITED STATES ENGINEER OFFICE,
Mobile, Ala., October 21, 1884.

SIR: I have the honor of submitting the following report upon the preliminary examination of Homosassa Bay, Florida, ordered by circular letter dated July 31, 1884:

In my opinion this bay is unworthy of improvement, for the following reasons:

The cost of deepening the outside entrance, the inside channel through the north gap, or straightening and deepening the channel at the mouth of the river, would be from $100,000 to $180,000 to obtain a channel of navigable width and of 6 feet depth.

The commerce is small in amount, with no prospect, so far as could be learned, of any great increase.

The commerce consists in shipments of oranges to Cedar Keys, 40 miles distant, in light-draught boats, and cattle to Tampa by land, but no exact statement of the amount could be obtained.

The nature of the improvement desired or by whom desired could not be ascertained.

Respectfully submitted.

A. N. DAMRELL,
Major of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

Q 13.

PRELIMINARY EXAMINATION OF BACK BAY AT HANDSBOROUGH, MISSISSIPPI.

UNITED STATES ENGINEER OFFICE,
Mobile, Ala., October 3, 1884.

SIR: I have the honor of submitting the following report upon the preliminary examination of Back Bay at Handsborough, Mississippi Sound, ordered by circular letter of July 31, 1884.

Handsborough is a small town of about 200 inhabitants, on Bayou Bernard, about 2½ miles from its mouth.

The bayou is about 150 feet wide and 15 feet deep, entering Back Bay at its western end about 14½ miles from the 8-foot curve in Mississippi Sound.

The obstructions to navigation are as follows:

(1) A bar called "Crane's Neck," at the mouth of the bayou, about one-fourth mile, 4 feet minimum depth.

(2) The channel through the Back Bay is narrow and crooked, with only 4 feet minimum depth.

(3) A bar at Barnard's Island, separating Back Bay and Biloxi Bay. This bar is a short one, but has a minimum depth of only 4 feet.

(4) Biloxi Bay Mud Flats, about 1 mile in length and 4 feet minimum depth.

(5) A bar 2 miles in length and 4 feet minimum depth, separating Biloxi Bay from 8-foot curve in Mississippi Sound.

In my opinion this bay is not worthy of improvement.

The facts upon which my judgment is based are as follows:

The cost of the improvement would probably exceed $140,000. The value of the annual commerce to be benefited would probably be very small. The only commerce at present is the shipment of lumber from one mill, estimated by owners at 5,000,000 feet, B. M. The same party owns a brick-yard for which he claims a capacity of 3,600,000 annually. Four saw-mills formerly in operation there have stopped work on account of scarcity of saw-logs. There is no apparent reason to suppose that the improvement would increase the commerce to any great extent.

Very respectfully, your obedient servant,

A. N. DAMRELL,
Major of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

Q 14.

PRELIMINARY EXAMINATION OF MOBILE RIVER AND HARBOR FROM LOWER ANCHORAGE UP TO THE NORTHERN LIMITS OF THE CITY OF MOBILE, WITH A VIEW TO SECURING TWENTY-THREE FEET DEPTH OF WATER.

UNITED STATES ENGINEER OFFICE,
Mobile, Ala., October 22, 1884.

SIR: I have the honor of submitting the following report upon the preliminary examination of "Mobile River and Harbor from the lower anchorage up to the northern limits of the city of Mobile, with a view to securing 23 feet depth of water."

In my opinion the river and harbor is worthy of improvement for the following reasons:

1. The cost of the improvement will not probably exceed $1,500,000. The present commerce is large, as shown in statements hereunto appended, which is greatly inconvenienced by the fact that the draught of the vessels seeking the port for cargoes is such that the present depth of water only allows them to take on a part of their cargoes at the wharves and compels them to finish loading in the lower bay, 28 miles distant, by lightering and rafting. The prospects for an extensive increase, in the near future, with the improvement effected, are sure.

2. The harbor is destined to be a very important one to the United States Government, as being the point on the Gulf where the cheapest coal and iron can be obtained, owing to the fact that it is connected by three short water routes, the Cahaba, the Black Warrior, and Coosa rivers, with the coal and iron deposits of Alabama.

No survey will be necessary, as a survey and report has already been

made and considered by the Board of Engineers for River and Harbor Improvements, whose report is contained in the Annual Report of the Chief of Engineers for 1880.

Respectfully submitted.

A. N. DAMRELL,
Major of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

Entrances and clearances at port of Mobile, Ala.

Direction, &c.	ENTRANCES.				CLEARANCES.			
	June 30, 1884.		June 30, 1883.		June 30, 1884.		June 30, 1883.	
	Vessels.	Tonnage.	Vessels.	Tonnage.	Vessels.	Tonnage.	Vessels.	Tonnage.
Foreign	165	114,141	105	60,602	155	105,714	112	66,998
Coastwise	66	22,555	51	18,379	54	17,788	50	18,551
American	50	9,015	42	7,885	51	10,088	54	11,492
Total	281	145,711	198	86,866	260	133,590	216	97,041

COMMERCIAL STATISTICS.

Items.	June 30, 1884.	June 30, 1883.
Duties on imports	$50,324 50	$200,742 12
Tonnage dues	22,517 70	12,833 50
Hospital collections	3,742 79	3,750 32
Miscellaneous	5,012 67	4,811 28
Total	81,597 67	222,137 22

EXPORTS TO FOREIGN PORTS.

June 30, 1884	$3,836 449
June 30, 1883	2,837,496

IMPORTS OF FOREIGN GOODS.

June 30, 1884	282,786
June 30, 1883	390,535

IMPROVEMENT OF MOBILE RIVER AND HARBOR, ALABAMA.

UNITED STATES ENGINEER OFFICE,
Mobile, Ala., February 6, 1885.

SIR: I have the honor of submitting the following report upon the improvement of "Mobile River and Harbor from the lower anchorage up to the northern limits of the city of Mobile, with a view to securing 23 feet depth of water." As stated in the report upon the preliminary examination, no survey was necessary, as one had already been made and considered by the Board of Engineers for River and Harbor Improvements, which submitted a project for obtaining a channel of 22 feet depth from the lower bay to the city, February 28, 1880.

In that report it was suggested that a small cut be dredged in the present channel to a depth of 22 feet, on Dog River Bar, to determine experimentally whether a deep excavation would remain open or be filled by the flowing in of the mud from the banks.

This cut was made and sounded from time to time. The results would seem to indicate that no material filling need be feared, provided that the cut be made sufficiently wide and a proper slope be given to the banks.

This fact, when considered in connection with the generally satisfactory condition of the channel, of 17 feet depth, now being dredged, and which will be completed, probably, next year, would seem to warrant the conclusion that the cheapest and quickest, if not the best, method now of obtaining the depth desired, which is that existing on the inner bar, would be by enlarging and deepening, by dredging, the channel, which, since 1870, has been deepened in that manner, first from 9 feet to 13 feet and then from 13 to 17 feet. To secure a channel 280 feet wide on top with a central depth of 23 feet, would require the excavation and removal of about 9,000,000,000 cubic yards of material—mud, sand, and shells—at a cost of about $1,500,000, supposing the channel of 17 feet depth completed to its proposed width of 200 feet, and prices for dredging to be as favorable as have recently prevailed.

An appropriation of $500,000 would probably give in one year a channel sufficiently wide and deep to permit the passage of nearly all vessels of the class now coming to this port, with full loads, and no relief will be furnished to commerce with a less expenditure.

As the project calls for the expenditure of a large amount of money, and as it varies from that recommended by the Board of 1880, being based upon data not then available, I would recommend that it be referred to the present Board for their consideration.

As stated in my report upon the preliminary examination—

1st. The cost of the improvement will not probably exceed $1,500,000. The present commerce is large, as shown in statements hereunto appended, which is greatly inconvenienced by the fact that the draught of the vessels seeking the port for cargoes is such that the present depth of water only allows them to take on a part of their cargoes at the wharves, and compels them to finish loading in the lower bay, 28 miles distant, by lightering and rafting. The prospects for an extensive increase in the near future, with the improvement effected, are sure.

2d. The harbor is destined to be a very important one to the United States Government, as being the point on the Gulf where the cheapest coal and iron can be obtained, owing to the fact that it is connected by three short water-routes—the Cahaba, the Black Warrior, and Coosa rivers—with the coal and iron deposits of Alabama.

Respectfully submitted.

A. N. DAMRELL,
Major of Engineers, U. S. A.

The CHIEF OF ENGINEERS, U. S. A.

APPENDIX R.

INSPECTION OF THE IMPROVEMENT AT THE SOUTH PASS OF THE MISSISSIPPI RIVER.

REPORT OF MAJOR W. H. HEUER, CORPS OF ENGINEERS, INSPECTING OFFICER, FOR THE FISCAL YEAR ENDING JUNE 30, 1885.

OFFICE UNITED STATES ENGINEER,
New Orleans, La., July 16, 1885.

GENERAL: I have the honor to forward herewith the annual report of the progress of the work on the improvement of the South Pass of the Mississippi River for the fiscal year ending June 30, 1885.

The examination and survey were in charge of Capt. Thomas Turtle, Corps of Engineers, until February 12, 1885, when it was retransferred to me.

Mr. C. Donovan, assistant engineer, has remained in local charge of the surveys at the Pass during the year, and his report, which is full of interesting details, is appended. It shows all changes which have occurred within the past year, and many of those which have resulted in the past ten years.

One of the interesting facts connected with the improvement is that the full depths and widths of channels required by law have been maintained throughout the year by Mr. Eads, and that no dredging of any kind has been required on any of this work since February, 1883.

No work has been done in the Pass or at the Head of the Passes during the year. The inner east jetty has been extended 605 feet. The main jetties where covered with concrete blocks still continue to settle slightly, the subsidence for the year averaging a little less than 2 inches.

Near the head of the Pass, in September and October of 1884, the channel shoaled to a depth of 26.4 feet, but in February following the depth increased to 33.7 feet. This has again shoaled to a depth of 30.6 feet in consequence of a falling river. The 30-foot channel at this locality is now 100 feet wide.

In the Pass itself no change of any consequence has occurred during the year; the shoalest areas, those near Bayou Grande and Goat Island, have deepened slightly. The profiles of the bottom, shown on Chart No. 6, show at a glance the immense scour which Mr. Eads's works have produced at the head of the Pass and on the bar at the jetties, as well as the extensive filling by deposits which have occurred throughout the Pass since work was commenced about ten years ago.

A complete survey of South Pass made in November, 1884, showed that it had a channel throughout whose least depth was 27 feet, and that except for about one-half mile there was a channel whose least central depth was 30 feet.

Between the jetties during the year there has been some shoaling, varying from 2 to 10 feet in height, but as this shoaling has occurred in the deepest part of the channel, no harm has resulted. At present there is a channel through the jetties whose least depth is 31.3 feet. There is also a 30-foot channel whose least width is 130 feet, and a 26-foot channel having a least width of 270 feet.

Attention is invited to that portion of the Chart No. 1 showing the channel in the Gulf about 500 feet beyond the outer ends of the jetties. There we find the *legal* channel 26 feet deep, having a width of 230 feet and a central depth of 30 feet or more; but this channel makes such a sharp bend or turn of about 90 degrees that I believe it would be impracticable for a vessel drawing 25 or 26 feet to make the turn without grounding on the shoals on either side. Attention is invited to this point, to illustrate that a legal channel may not be a navigable one.

The survey recently made by Mr. Donovan on what is known on our reports as the fan-shaped area beyond the ends of the jetties shows that this area has deepened or scoured during the year an average depth equal to 1.16 feet, whereas during the previous year it had shoaled or deposited 3.61 feet in vertical height.

A scour 1.16 feet deep over this area means the removal of about 1,500,000 cubic yards more of material than was deposited there in the same time. There still remains in this area, embracing about 1¼ square miles, a deposit or fill averaging 7.13 feet in height and estimated roughly to contain over 9,000,000 of cubic yards of deposit. This is approximately the excess of deposit over scour that has lodged on this portion of the bar during the past nine years.

The bar growth beyond the jetties is well illustrated by Mr. Donovan, in Plates I and II of this report. These plates show the gradual but sure advance seaward of each curve during each year since the jetties were commenced.

Considering the channel in the Pass, in the jetties, and just beyond the jetties during the year as a whole, it is in better condition now than it was at the end of the previous year.

Acknowledgments are due Mr. Donovan for valuable and satisfactory services.

ESTIMATE OF FUNDS REQUIRED FOR EXAMINATIONS AND SURVEYS AT SOUTH PASS OF THE MISSISSIPPI RIVER, DURING THE FISCAL YEAR ENDING JUNE 30, 1887.

2 assistant engineers	$4,500
1 recorder	1,200
1 steam engineer	1,200
1 water-level observer	120
6 seamen	4,680
Rent of office	180
Rent of assistant engineers' quarters	240
Mileage and traveling expenses	200
Fuel for launch and office	350
Repairs to launches and boats	1,200
Material and supplies for launches	250
Stationery and supplies for office	200
Contingencies	2,600
Total	16,920

Money statement.

July 1, 1884, amount available	$13,296 80
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	9,447 36
Amount available for fiscal year ending June 30, 1886	3,849 44
Amount that can be profitably expended in fiscal year ending June 30, 1887	16,920 00

Respectfully submitted.

W. H. HEUER,
Major of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

REPORT OF MR. C. DONOVAN, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Port Eads, La., July 10, 1885.

SIR: I have the honor to submit my report for the fiscal year ending June 30, 1885, upon the improvement of South Pass of the Mississippi River. This work is carried on under the direction of Mr. James B. Eads by authority granted him in an act of Congress approved March 3, 1875.

A period of ten years has now elapsed since the work of construction for this improvement was commenced, and in this report will be found the results obtained and comparisons made to show what channel improvement has been effected not only during he year, but throughout the period of ten years.

The following charts and plates accompany this report:

No. 1.—Chart of channel from opposite South Pass light-house to the end of the jetties.
No. 2.—Chart of a part of the Gulf of Mexico, showing depths out to that of 100 feet.
No. 3.—Chart of South Pass, from South Pass light-house to Bayou Grande.
No. 4.—Chart of South Pass, from Bayou Grande to Head of Passes.
No. 5.—Chart of the Head of Passes.
No. 6.—Plan and comparative profiles of South Pass.
No. 7.—Sections and profiles at Head of Passes.
Plates I and II.—Diagrams showing changes in the Gulf from 1877 to 1885.

AT THE HEAD OF THE PASSES AND IN SOUTH PASS.

No work has been done at the Head of the Passes since July, 1879, nor has any been done in South Pass during the year.

From an inspection of Charts 3, 4, and 5 it will be seen that most of the works of construction are buried by deposits, which they have caused to accumulate, and portions not so buried are beneath the surface of the water, except the piling, and that is badly decayed.

No change has taken place in east T-head extension or upper dam during the year except that through the easterly break in the latter the depth has become 2 to 6 feet shoaler by sediment being deposited on the foundation mattresses.

These works at the head of and throughout South Pass have served the purpose for which they were constructed by causing the river to build new banks, which in turn protect the works of construction, and, even in the most exposed places, I have found that while the foundation-mattresses are in place the constructions are effectual.

MATTRESS-SILLS ACROSS SOUTHWEST AND NORTHEAST PASSES.

The foundation course of the sill across Southwest Pass was laid in October, 1876, and in December, 1878, three more courses were added, each being shorter than the other, commencing near the west shore of the Pass and extending only part way across it.

The first soundings made on this sill after its completion were in March, 1879, since then and up to the present time this sill has remained in place and has settled uniformly about 2 feet throughout most of its length. About 200 feet from the east end a mattress seems to have washed out during the past year. From 300 to 500 feet from the east end there has been a settlement of 7 feet since 1879.

The sill across Northeast Pass was laid in September, 1876; it has since remained in place, and settled quite uniformly about 2 feet. Over 500 feet in length of it, commencing 1,200 feet from the east end, there has been a deposit during the past year,

which leaves the depth of water over the sill for this distance about the same as it was when the sill was first laid.

AT THE MOUTH OF SOUTH PASS.

The condition of the main jetties has not changed during the year, and no work has been done upon them, and all that can be noted in connection with them is the subsidence of the concrete capping over a portion of each.

The subsidence of portions of the concrete wall on the east jetty not damaged by the storm of September 9, 1882, has been as follows:

	Feet.
Average subsidence during the year	0.12
Average subsidence for five years	1.34

The subsidence of 154 blocks of concrete on the west jetty has been as follows:

	Feet.
Average subsidence during the year	0.15
Average snbsidence during six years	1.53

INNER EAST JETTY.

The construction of this jetty has been the subject of most of the work done at the mouth of the Pass during the past two years, and is described in my report for 1883 (see page 1036, Appendix N, of the Annual Report of the Chief of Engineers for 1883).

During the year, 605 linear feet were built between Wing-Dams 22 and 23, near the end of the east jetty.

This portion contains four rows of piles 7 feet apart, the piles in each row being from 6 to 8 feet apart; the piles in the two rows nearest the channel, and part of those in the third row, are connected by 12 by 12 inch timbers bolted to them near their tops. The spaces between the piles are filled with willows which are heavily ballasted with stone.

From time to time it has been necessary to add willows and stone to portions of this jetty previously built, where it had settled below the surface of the water, and it is now in good condition and from 2 to 5 feet above average flood tide throughout its entire length.

In the construction and maintenance of this jetty the following materials were used during the year, viz, 304 piles, 1,446 linear feet of 12 by 12 inch timber, 219 bolts 1 inch diameter and 2 feet long, 7,696 cords of willows, and 2,535 cubic yards of stone.

WING-DAMS.

The wing-dam connecting the extreme end of the east jetty with that of the inner jetty was considerably shattered during the stormy season by heavy seas beating against it, and much of the stone with which it was heavily ballasted was rolled off into the water. This dam has been repaired by replacing the crib-work upon a foundation of willows and filling the cribs with stone. It is now in excellent condition, its upper surface being 7 feet above average flood tide.

The following materials were placed in this dam: 447 cords of willows, 64 piles, 1,064 cubic yards of stone, and 382 linear feet of 12 by 12 inch timber.

DREDGING.

No dredging has been done since February 22, 1883. The dredge-boat is now employed at Pensacola, Fla.

THE PLANT.

There has recently been received here two steel barges, each 90 feet long, 20 feet wide, and 4½ feet deep, and one 60 feet long, 20 feet wide, and 4 feet deep, and another of the latter dimensions is on the way here. They are built of steel plates three-sixteenths of an inch thick.

During the year one flat-boat and pile-driver was built, a dredge-boat, tug-boat, four flat-boats, and one barge repaired, and thirty-nine piles driven at different points for moorings.

Much ballast material has been discharged from vessels and distributed.

FORCE EMPLOYED.

The average force employed during the year, including officers, mechanics, and laborers, was thirty in number.

EXAMINATIONS AND SURVEYS.

The results of examinations and surveys made during the year were reported monthly, and in this report will be found not only the results from my latest surveys, but also a recapitulation of those obtained from month to month during the year, and from year to year during a period of years.

The methods of presenting and comparing these results, both graphically and in tabular form, have been followed for several years, and when understood one may gain detailed information concerning the changes which have taken place throughout the channel and in the Gulf, which could not be conveyed by a written description of them.

The results of tidal sediment and velocity observations were presented in my report last year (see Chart No. 7 in Appendix O of the Annual Report of the Chief of Engineers for 1884), and included those obtained during a period of seven and a half years; and as the results obtained during the past year add nothing of interest to those already presented, they are omitted at this time.

AT THE HEAD OF THE PASSES.

The chart of the survey in this locality is No. 5, and on Chart No. 7 comparative profiles and sections are given, which explain the changes which have taken place during the year and since 1875.

The depth of water at the head of each of the three passes fluctuated, during the year, with the stage of the river. In July, 1884, when the river began to fall, this area commenced to shoal, and the channel into South Pass attained a least depth of 26.4 feet, for the year, during the months of September and October, while the river was lowest. As soon as the December rise commenced this area began to scour, and when the river was at its high stage in February the channel into South Pass had a depth of 33.7 feet. Now that the river is again falling this area has commenced to shoal.

Using sections G H and I J, Chart No. 7, it will be seen that there has been a shoaling during the year, most of which has taken place above upper dam, extending upward and to the eastward, shoaling the entrance to Northeast Pass, and downward to the mattress sill across that Pass.

The comparative Profiles E F show that the depth into Northeast Pass is but little more than it was in 1875, and hence the deepening which has taken place during previous years has been almost entirely obliterated during the past year.

From Profiles A B and C D we learn that the result for the year has been a shoaling, and from C D we find, as in Northeast Pass, that the depth into Southwest Pass is but little different from what it was in 1875, while from A B we note the great deepening into South Pass; and thus, taking the results up to the present time, we see that the desired deepening into South Pass has been produced while the two larger passes have been controlled.

From the above, therefore, we find that there has been a shoaling during the year and a deepening since 1875.

On June 15 there was a least depth of 30.6 feet from the main river into South Pass, with a least width of 100 feet for the 30-foot channel, and a very wide 26-foot channel.

SURVEY OF SOUTH PASS FROM ITS HEAD TO SOUTH PASS LIGHT-HOUSE.

During the month of November I made a complete survey of South Pass, the charts of which are Nos. 3 and 4.

As compared with a similar survey made during the same month in 1883, I find that practically there has been no change throughout the Pass during the year. Some reaches have shoaled a little while others have deepened. The shoaler areas above Goat Island and near Bayou Grande have deepened.

As compared with the survey of 1875 there has been a decided shoaling throughout the Pass, as will be seen from an inspection of the profiles on Chart No. 6. From them it will be seen that the greatest shoaling has taken place above Bayou Grande, and is from 5 to 14 feet in vertical height, while below the bayou it varies from 2 to 6 feet. Attention is invited to the information contained on this chart. The changes which have taken place throughout the entire channel from the main river to the Gulf since 1875, will be found of interest and importance; and the great deepening at the head and mouth of the Pass; the fact that the shoaler areas have been controlled, and, finally, the tendency towards uniformity of depth accordingly as uniformity of width is obtained, will be readily appreciated.

On June 15 the channel near Bayou Grande had a least depth of 29.2 feet, the least width of the 26-foot channel being 350 feet.

At other localities throughout the pass the depth and width of the channel is substantially as shown on Charts 3 and 4, and as are contained in the following table:

Tabulated statement of the depth and width of channel throughout South Pass of the Mississippi River, from East Point to 30-foot depth in the main river, given in separate reaches one-fourth of a mile in length, from a survey made in November, 1884.

Locality.		Least available depth.	Least width for	
From—	To—		26-foot depth.	30-foot depth.
East Point	¼ mile above East Point	29.8	300	(*)
¼ mile above East Point	½ mile above East Point	30.0	320	80
½ mile above East Point	¾ mile above East Point	32.6	360	140
¾ mile above East Point	1 mile above East Point	33.5	350	180
First mile		29.8	300	.....
1 mile above East Point	1¼ miles above East Point	32.5	400	130
1¼ miles above East Point	1½ miles above East Point	31.6	400	140
1½ miles above East Point	1¾ miles above East Point	30.0	450	90
1¾ miles above East Point	2 miles above East Point	30.2	440	60
Second mile		30.0	400	60
2 miles above East Point	2¼ miles above East Point	31.2	450	180
2¼ miles above East Point	2½ miles above East Point	31.2	430	280
2½ miles above East Point	2¾ miles above East Point	32.8	410	330
2¾ miles above East Point	3 miles above East Point	32.0	410	360
Third mile		31.2	410	180
3 miles above East Point	3¼ miles above East Point	31.8	440	210
3¼ miles above East Point	3½ miles above East Point	31.8	400	150
3½ miles above East Point	3¾ miles above East Point	30.8	450	140
3¾ miles above East Point	4 miles above East Point	32.5	470	300
Fourth mile		30.8	400	140
4 miles above East Point	4¼ miles above East Point	37.1	450	310
4¼ miles above East Point	4½ miles above East Point	33.9	470	290
4½ miles above East Point	4¾ miles above East Point	34.8	450	310
4¾ miles above East Point	5 miles above East Point	36.7	330	220
Fifth mile		33.9	330	220
5 miles above East Point	5¼ miles above East Point	30.6	330	100
5¼ miles above East Point	5½ miles above East Point	29.2	510	(†)
5½ miles above East Point	5¾ miles above East Point	30.1	340	70
5¾ miles above East Point	6 miles above East Point	31.2	280	90
Sixth mile		29.2	280	.....
6 miles above East Point	6¼ miles above East Point	31.2	420	100
6¼ miles above East Point	6½ miles above East Point	30.2	450	260
6½ miles above East Point	6¾ miles above East Point	33.1	440	290
6¾ miles above East Point	7 miles above East Point	33.5	410	320
Seventh mile		30.2	410	100
7 miles above East Point	7¼ miles above East Point	32.5	480	310
7¼ miles above East Point	7½ miles above East Point	32.5	460	360
7½ miles above East Point	7¾ miles above East Point	36.4	380	300
7¾ miles above East Point	8 miles above East Point	40.2	350	290
Eighth mile		32.5	350	290
8 miles above East Point	8¼ miles above East Point	36.1	410	290
8¼ miles above East Point	8½ miles above East Point	34.1	480	310
8½ miles above East Point	8¾ miles above East Point	34.1	300	200
8¾ miles above East Point	9 miles above East Point	35.1	270	180
Ninth mile		34.1	270	180
9 miles above East Point	9¼ miles above East Point	33.1	320	180
9¼ miles above East Point	9½ miles above East Point	30.3	400	80
9½ miles above East Point	9¾ miles above East Point	30.3	430	80
9¾ miles above East Point	10 miles above East Point	46.0	320	290
Tenth mile		30.3	320	80

* Length of the portion of this reach lacking a central depth of 30 feet, 1,100 feet.
† A central depth of 30.5 feet—30-foot channel 90 feet wide, but too tortuous to be available.

Tabulated statement of the depth and width of channel throughout South Pass of the Mississippi River, &c.—Continued.

Locality.		Least available depth.	Least width for	
From—	To—		26-foot depth.	30-foot depth.
10 miles above East Point	10¼ miles above East Point	41.0	320	270
10¼ miles above East Point	10½ miles above East Point	41.0	450	330
10½ miles above East Point	10¾ miles above East Point	41.0	380	280
10¾ miles above East Point	11 miles above East Point	39.0	400	300
Eleventh mile		39.0	320	270
11 miles above East Point	11¼ miles above East Point	40.0	900	700
11¼ miles above East Point	11½ miles above East Point	27.9	600	(*)
11½ miles above East Point	11¾ miles above East Point	27.0	300	(†)
11¾ miles above East Point	12 miles above East Point	‡30.0	.....	.....
Twelfth mile		27.0	300	.....

* Length of the portion of this reach lacking a central depth of 30 feet, 550 feet.
† Length of the portion of this reach lacking a central depth of 30 feet, 1,130 feet.
‡ In Mississippi River above head of passes.
Total length of channel lacking a central depth of 30 feet, 2,780 feet.

THE CHANNEL THROUGH THE JETTIES.

The channel through the jetties is shown on Chart No. 1. It has shoaled during the year an amount varying from 2 to 5 feet in vertical height, the greatest shoaling having occurred throughout the deepest reach from 3,000 to 7,000 feet below East Point, and varies from 6 to 10 feet in vertical height.

The changes in the depth and width of this channel which have taken place from month to month during the year will be seen from the following table:

Tabulated statements regarding the minimum depths and widths of channel through the jetties, in separate reaches of 2,000 feet each, according to surveys made monthly during the fiscal year ending June 30, 1885.

Date on which soundings were made.	Distances from East Point, in feet.																	
	0–2,000.			2,000–4,000.			4,000–6,000.			6,000–8,000.			8,000–10,000.			10,000–12,000.		
	Least depth.	Least width for—		Least depth.	Least width for—		Least depth.	Least width for—		Least depth.	Least width for—		Least depth.	Least width for—		Least depth.	Least width for—	
		26-foot depth.	30-foot depth.		26-foot depth.	30-foot depth.		26-foot depth.	30-foot depth.		26-foot depth.	30-foot depth.		26-foot depth.	30-foot depth.		26-foot depth.	30-foot depth.
1884.																		
June	35	300	150	35.8	350	300	41.1	380	320	34	270	200	35	300	210	35	290	180
August	31.9	310	150	35.8	340	300	41.9	390	320	33.9	290	190	35	310	170	32	260	140
September	32	310	190	34	350	300	39	390	330	33.1	280	180	33.7	320	140	33.5	240	140
October	31.1	300	120	33.4	340	270	38.6	380	310	32.6	260	160	32.6	260	160	32.5	240	80
November	32.8	300	100	32.8	320	260	37.2	340	300	32.2	270	180	32.4	260	120	30.8	220	80
December	31.6	290	110	32.6	330	270	37.1	360	290	31.1	250	140	31.5	260	130	31.4	230	80
1885.																		
January	36.7	300	210	36.4	340	300	36.9	360	300	33.1	240	180	34.6	260	190	32.8	270	190
February	41.7	260	180	36.3	340	280	35.7	360	310	30.5	260	140	34.1	280	180	36.2	290	220
March	35.5	310	160	36	330	260	36.1	370	280	31	250	120	31.7	240	140	35.7	370	210
April	36	300	180	35.5	340	290	37	350	300	32	280	180	32.6	280	150	32	220	110
May	36.7	340	170	35	330	280	35.6	360	290	31.5	290	180	33.5	300	160	31.5	340	160
June	34.7	330	190	33.7	340	300	35.7	360	270	32.8	270	160	32.8	280	130	31.3	270	130

According to the above, the least depth through the jetties at present is 31.3 feet; the least width of the 26-foot channel is 270 feet, and of the 30-foot channel 130 feet.

Beyond the ends of the jetties there is a central depth of 31.6 feet, the 26 and 30 feet channels being 220 and 80 feet wide respectively.

The depth over the shoal area east of the east jetty has increased about 1 foot during the year; the reef receded but little, and the portion which washed away last year has again reformed.

The area west of the west jetty is above the surface of the water at low tide, and most of it is so at average flood tide.

The following table gives the minimum depths of channel through the jetties at various dates since the commencement of the works of improvement, and serves to show the progressive channel improvement from that time to the present:

Table giving the depths of water through the jetties at various dates.

Date.	Distances from East Point, in feet.					
	0 to 2,000.	2,000 to 4,000.	4,000 to 6,000.	6,000 to 8,000.	8,000 to 10,000.	10,000 to 12,000.
1875.						
June	22.5	18.7	16.7	10.2	9.7	9.2
1876.						
May	23.3	20.3	22.0	21.0	17.1	15.0
August	23.5	19.6	21.0	23.5	23.0	19.8
November	22.0	20.3	21.1	21.2	21.1	20.3
1877.						
March	24.1	21.1	23.2	22.0	21.2	20.5
July	24.9	24.0	26.0	23.8	23.5	20.3
October 25 to December 14	26.3	24.4	28.5	24.2	23.0	23.7
1878.						
March	26.0	25.9	35.5	25.4	24.3	23.0
December	28.4	26.4	35.7	27.1	25.3	23.0
1879.						
March	28.6	27.5	43.4	27.0	27.0	27.0
June	27.5	28.4	47.7	29.2	2912	28.0
July 8	30.5	30.7	.....	31.0	30.7	30.5
December	31.0	31.0	48.3	31.7	31.8	30.8
1880.						
June	31.0	32.5	47.8	31.4	35.1	32.0
July	30.5	31.0	44.0	30.8	31.5	30.5
August	30.5	30.4	46.0	32.0	32.0	30.5
September	30.7	31.0	44.4	30.6	32.0	31.0
October	31.0	31.5	41.0	30.3	31.0	30.5
November	30.6	31.0	40.3	30.8	30.9	30.5
December	30.9	30.6	43.0	30.8	31.0	30.3
1881.						
January	30.5	30.4	41.9	33.8	30.7	30.3
February	30.4	30.2	41.6	32.0	31.0	30.0
March	31.5	31.2	41.3	32.0	32.0	30.5
April	30.4	30.0	43.0	33.0	33.0	30.5
May	30.2	30.5	42.7	32.6	30.5	31.2
June	30.0	30.5	43.8	32.0	31.7	31.7
July	31.0	32.0	42.5	33.5	33.0	32.0
August	30.1	32.0	37.6	32.0	31.0	30.2
October	30.2	30.3	38.3	31.4	31.2	30.3
November	30.8	31.8	39.2	30.4	30.0	30.1
December	30.2	32.8	39.4	30.8	30.2	30.0
1882.						
January	30.5	30.4	41.3	31.1	30.2	30.2
February	31.8	36.0	39.7	30.5	30.8	30.7
March	31.2	30.6	39.2	30.8	31.6	32.5
April	31.7	32.6	39.6	30.5	30.3	33.0
May	30.5	32.5	39.4	31.0	31.3	31.0
June	30.8	35.5	39.0	31.2	31.3	31.0
July	30.0	32.7	38.7	30.6	31.3	31.5
August	30.3	32.2	38.1	31.8	31.8	30.5
September	30.1	31.5	38.3	31.9	30.8	30.5
October	30.0	31.0	37.1	31.0	31.4	31.2
November	30.0	32.0	38.1	21.5	31.2	31.2
December	31.0	31.0	37.0	31.2	31.0	30.4
1883.						
January	31.0	31.0	35.2	30.2	30.1	30.1
February	31.2	31.2	36.0	30.5	30.0	30.1

Table giving the depths of water through the jetties at various dates—Continued.

Date.	Distances from East Point, in feet.					
	0 to 2, 000.	2, 000 to 4, 000.	4, 000 to 6, 000.	6, 000 to 8, 000.	8, 000 to 10, 000.	10, 000 to 12, 000.
1883.						
March	32. 3	32. 6	45. 7	31. 5	30. 3	30. 3
April	33 7	35. 0	44. 0	32. 2	30. 0	39. 0
May	33. 2	36. 3	46. 0	32. 3	30. 3	32. 4
June	32. 5	34. 2	45. 0	33. 4	31. 0	33. 0
July	33. 8	34. 9	44. 0	32. 0	31. 5	31. 8
August	32. 1	38. 2	48. 0	33. 4	33. 4	32. 2
September	33. 4	34. 3	46. 0	32. 3	32. 3	30. 6
October	32. 7	34. 1	41. 5	32. 0	32. 0	30. 5
November	31. 0	33. 8	43. 8	34. 5	31. 5	31. 0
December	30. 5	32. 6	43. 0	31. 6	31. 0	30. 2
1884.						
January	31. 2	32. 2	39. 2	32. 7	31. 8	30. 3
February	32. 0	31. 5	41. 3	31. 6	31. 0	30. 7
March	35. 7	39. 5	41. 6	34. 0	33. 8	38. 4
April	35. 3	37. 3	41. 5	31. 7	32. 7	35. 7
May	34. 9	35. 8	42. 3	34. 3	35. 1	33. 0
June	35. 0	35. 8	41. 1	34. 0	35. 0	35. 0
August	31. 9	35. 8	41. 9	33. 9	35. 0	32. 0
September	32. 0	34. 0	39. 0	33. 1	33. 7	33. 5
October	31. 1	33. 4	38. 6	32. 6	32. 6	32. 5
November	32. 8	32. 8	37. 2	32. 2	32. 4	30. 8
December	31. 6	32. 6	37. 1	31. 1	31. 5	31. 4
1885.						
January	36. 7	36. 4	36. 9	33. 1	34. 6	32. 8
February	41. 7	36. 3	35. 7	30. 5	34. 1	36. 2
March	35. 5	36. 0	36. 1	31. 0	31. 7	35. 7
April	36. 0	35. 5	37. 0	32. 0	32. 6	32. 0
May	36. 7	35. 0	35. 6	31. 5	33. 5	31. 5
June	34. 7	33. 7	35. 7	32. 8	32. 8	31. 3

SURVEY BEYOND THE ENDS OF THE JETTIES.

The chart of this survey is No. 5. The area sounded contains more than 2 square miles, the outer limit being the 100-foot curve.

By reference to Plate I it will be seen that the four inner curves—that is, the 20, 30, 40, and 50 feet ones—receded during the year, while those for greater depths advanced. The 60-foot curve shows but little change, and therefore marks the locality which has changed the least, or it may be considered the dividing line between the areas which have deepened and those which have shoaled. On this plate I have not considered each curve in three parts, as heretofore, for what I desired to establish has been proven during previous years, and that is that the same change is taking place over an area most directly in front of the jetties as is taking place to the eastward or westward of this central area, though in a less degree, and the results on Plate II sufficiently maintain this fact.

In my deductions by mean ordinates I have omitted the results for 1876, as the survey for that year did not extend as far to the westward as have those since made, and therefore a considerable and important western portion of the curves beyond 30 feet depth had to be omitted in order that an equitable comparison might be made with the results in 1876. I have taken the results in 1877 as a basis for comparisons by mean ordinates, but the results in 1876 is the basis for comparing mean depths.

From Plate II we see that since 1877 each portion of each curve has advanced, and that the curves of lesser depths show the greatest advance on the westward, and the least on the eastward, while the central portion has advanced the least.

Detailed information concerning the movement of each curve since 1877 will be found on this plate.

From an examination of Chart No. 2 it will be seen that but two of the curves which show an advance pass through the area which is compared by mean depths, and, since the majority of the curves within that area show a recession, it indicates that its depth has increased during the year.

I now determine the vertical height of this deepening over an area containing 1¼ square miles, and over each of twenty-one lesser areas into which it is subdivided, by obtaining the mean depth of each subdivision, and of the whole area, and comparing them with results similarly obtained for previous years.

The following table gives the results of these determinations and comparisons in detail:

No. of subdivision.	Area of subdivision in square feet.	Mean depth of subdivision, in feet.										Quantity of water overlying subdivision, in cubic yards.									
		1876.	1877.	1878.	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1876.	1877.	1878.	1879.	1880.	1881.	1882.	1883.	1884.	1885.
1	3, 359, 484	98. 0	86. 3	93. 13	89. 47	93. 87	88. 68	86. 84	88. 70	85. 30	87. 39	12, 193, 680	10, 737, 893	11, 712, 156	11, 133, 335	11, 680, 428	11, 033, 790	10, 805, 592	11, 036, 520	10, 613, 728	10, 873, 654
2	1, 951, 904	73. 0	76. 43	78. 12	71. 70	70. 05	70. 50	69. 82	69. 05	66. 21	66. 06	5, 277, 360	5, 525, 320	5, 647, 511	5, 190, 423	5, 064, 106	5, 097, 072	5, 047, 191	4, 962, 672	4, 786, 502	4, 775, 875
3	3, 203, 900	72. 524	73. 458	72. 38	69. 32	67. 91	70. 11	68. 02	66. 69	63. 34	62. 58	8, 606, 200	8, 716, 392	8, 588, 820	8, 225, 954	8, 058, 639	5, 319, 105	8, 071, 693	7, 914, 468	7, 516, 587	7, 426, 165
4	1, 771, 511	67. 455	67. 877	66. 40	61. 32	61. 92	63. 46	60. 47	60. 05	57. 33	57. 86	4, 425, 860	4, 453, 514	4, 356, 630	4, 023, 625	4, 062, 665	8, 163, 967	3, 961, 162	3, 939, 772	3, 762, 097	3, 796, 085
5	3, 195, 900	75. 342	73. 319	77. 60	74. 26	76. 47	72. 21	71. 52	73. 18	66. 56	67. 78	8, 917, 980	8, 678, 488	9, 185, 253	8, 789, 980	9, 051, 617	8, 547, 376	8, 465, 109	8, 661, 835	7, 879, 196	8, 022, 774
6	1, 951, 904	76. 724	81. 0	75. 34	74. 12	75. 57	71. 81	72. 82	70. 70	67. 97	65. 86	5, 546, 570	5, 855, 700	5, 446, 535	5, 358, 410	5, 463, 379	1, 191, 196	5, 264, 429	5, 111, 096	4, 913, 809	4, 761, 055
7	3, 146, 568	63. 63	62. 45	66. 38	62. 66	73. 57	59. 82	56. 25	56. 56	53. 81	52. 70	7, 415, 403	7, 277, 886	7, 725, 899	7, 303, 062	7, 408, 419	6, 971, 623	6, 554, 878	6, 591, 477	6, 271, 570	6, 142, 217
8	1, 177, 965	58. 40	59. 50	59. 74	58. 20	58. 62	53. 23	52. 41	56. 95	51. 99	52. 11	2, 547, 905	2, 595, 882	2, 606, 356	2, 543, 532	2, 557, 449	2, 322, 466	2, 286, 779	2, 486, 597	2, 268, 368	2, 273, 515
9	1, 911, 590	53. 7826	53. 892	56. 30	56. 58	52. 63	50. 59	50. 05	52. 92	47. 15	49. 94	3, 807, 800	3, 815, 012	3, 986, 015	5, 005, 839	3, 726, 397	3, 581, 962	3, 543, 659	3, 746, 503	3, 338, 411	3, 535, 942
10	1, 804, 280	47. 9336	48. 845	51. 83	47. 70	49. 12	49. 41	45. 96	47. 54	43. 46	47. 73	3, 203, 170	3, 264, 076	3, 463, 548	2, 187, 621	3, 282, 921	3, 302, 099	3, 071, 285	3, 177, 060	2, 904, 824	3, 189, 565
11	1, 910, 900	52. 4822	54. 075	56. 38	54. 54	54. 80	53. 53	50. 63	47. 60	43. 37	47. 63	3, 714, 380	3, 827, 022	3, 990, 242	3, 860, 303	3, 878, 490	3, 788, 890	3, 583, 220	3, 369, 129	3, 069, 967	3, 370, 969
12	1, 177, 965	50. 5625	52. 144	49. 97	51. 05	50. 75	48. 35	46. 75	44. 33	41. 37	43. 36	2, 205, 950	2, 274, 950	2, 180, 110	2, 227, 400	2, 214, 138	2, 109, 604	2, 039, 755	1, 934, 161	1, 800, 253	1, 891, 811
13	2, 664, 385	36. 803	38. 438	39. 57	40. 35	39. 67	36. 34	36. 95	36. 06	34. 29	34. 36	3, 631, 752	3, 793, 096	3, 904, 805	3, 982, 775	3, 914, 672	3, 586, 460	3, 650, 997	3, 558, 138	3, 384, 657	3, 390, 972
14	354, 931	31. 464	37. 02	35. 00	34. 73	33. 63	32. 76	33. 47	32. 64	32. 17	31. 56	413, 612	486, 680	460, 095	456, 546	442, 086	440, 649	439, 983	424, 137	422, 920	414, 914
15	196, 900	35. 20	36. 325	40. 01	40. 26	35. 26	33. 11	34. 26	35. 25	32. 74	35. 67	256, 699	264, 803	291, 766	293, 599	257, 159	241, 468	249, 844	257, 085	238, 803	260, 141
16	395, 320	33. 377	36. 871	35. 92	39. 01	37. 43	33. 74	36. 47	37. 30	32. 98	33. 55	488, 689	533, 908	525, 922	571, 281	548, 133	494, 018	533, 989	546, 127	482, 964	491, 163
17	1, 658, 3 0	29. 2805	33. 256	32. 20	33. 16	32. 64	30. 32	28. 18	31. 98	26. 46	27. 50	1, 798, 376	2, 042, 546	1, 977, 689	2, 036, 957	2, 004, 528	1, 862, 282	1, 730, 600	1, 964, 237	1, 625, 389	1, 689, 203
18	390, 660	31. 444	32. 905	34. 00	35. 92	33. 07	29. 75	31. 22	32. 90	19. 97	23. 34	454, 959	477, 003	491, 942	519, 838	478, 515	430, 449	451, 762	471, 997	289, 059	337, 733
19	195, 900	37. 0833	35. 1	39. 43	39. 47	37. 69	37. 17	41. 78	39. 68	32. 08	36. 56	269, 090	254, 585	286, 086	286, 413	273, 469	269, 696	303, 115	287, 900	232, 780	265, 284
20	354, 931	35. 654	36. 85	37. 20	33. 47	32. 99	29. 62	29. 36	23. 57	17. 62	25. 00	468, 690	484, 415	489, 016	440, 088	433, 686	389, 434	385, 955	309, 920	231, 704	328, 600
21	1, 942, 785	35. 012	31. 723	36. 50	30. 93	28. 17	22. 55	22. 97	19. 11	20. 31	24. 34	2, 519, 288	2, 282, 681	2, 626, 357	2, 225, 567	2, 027, 548	1, 622, 656	1, 653, 166	1, 375, 060	1, 461, 909	1, 751, 744
	*34, 817, 993	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	78, 163, 422	77, 640, 825	79, 952, 753	76, 662, 548	76, 828, 444	73, 756, 267	72, 094, 163	72, 134, 878	67, 500, 497	68, 989, 381

*Square miles, 1.2453.

Mean depth over whole area:	*Feet.*
June, 1876	60. 78
June, 1877	60. 38
July, 1878	62. 18
July, 1879	59. 62
June, 1880	59. 74
June, 1881	57. 36
June, 1882	56. 06
June, 1883	56. 10
June, 1884	52. 49
June, 1885	53. 65

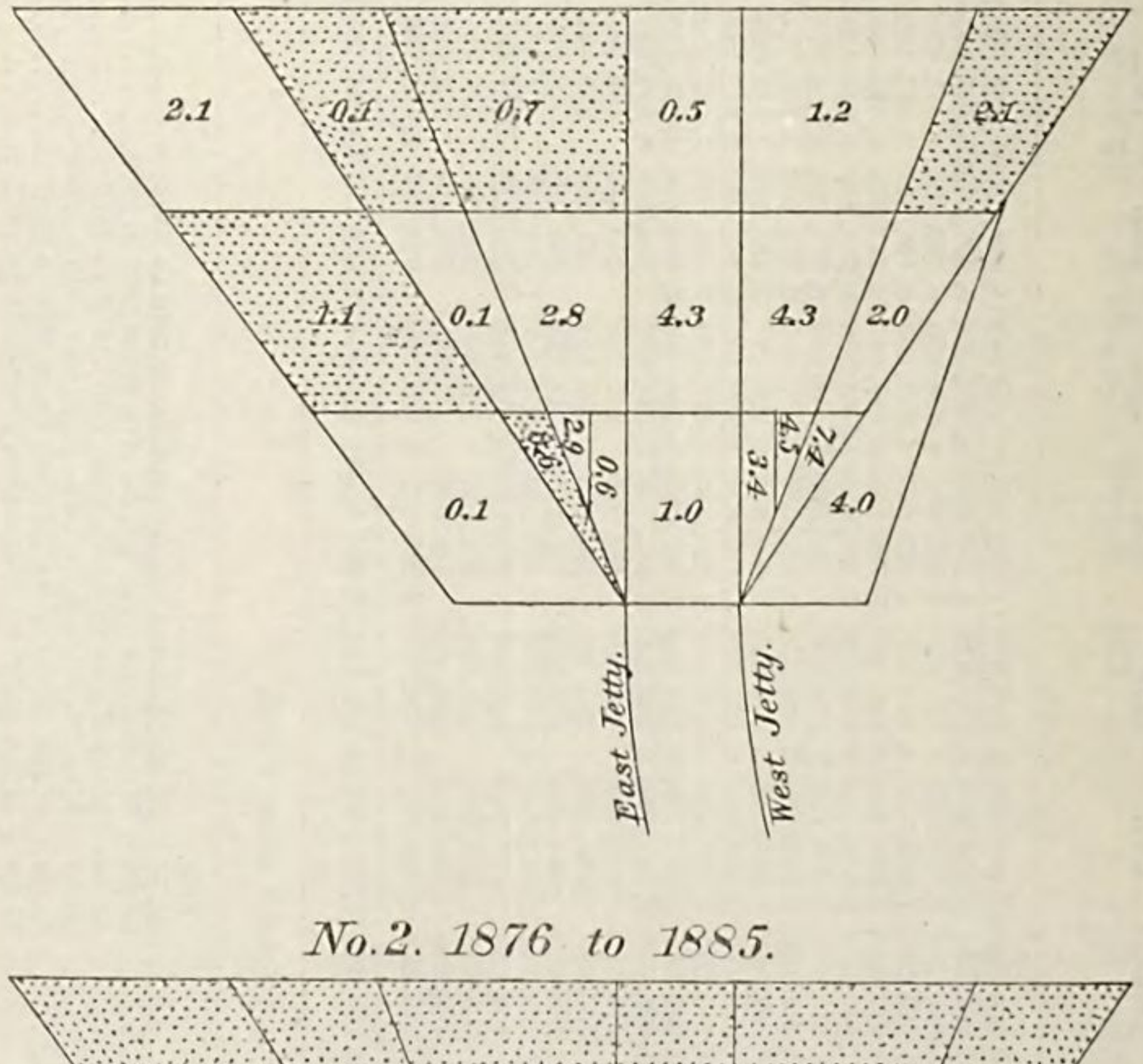
	Feet.
Mean fill over whole area from 1876 to 1877	0. 40
Mean scour over whole area from 1877 to 1878	1. 80
Mean fill over whole area from 1878 to 1879	2. 56
Mean scour over whole area from 1879 to 1880	0. 12
Mean fill over whole area from 1880 to 1881	2. 38
Mean fill over whole area from 1881 to 1882	1. 30
Mean scour over whole area from 1882 to 1883	0. 04
Mean fill over whole area from 1883 to 1884	3. 61
Mean fill over whole area from 1876 to 1884	8. 29
Mean scour over whole area from 1884 to 1885	1. 16
Mean fill over whole area from 1876 to 1885	7. 13

A clear understanding of the foregoing results will be aided by the following diagrams, which represent this area on a small scale, and they serve to show the distribution of the material deposited, and the localities of the areas which have deepened.

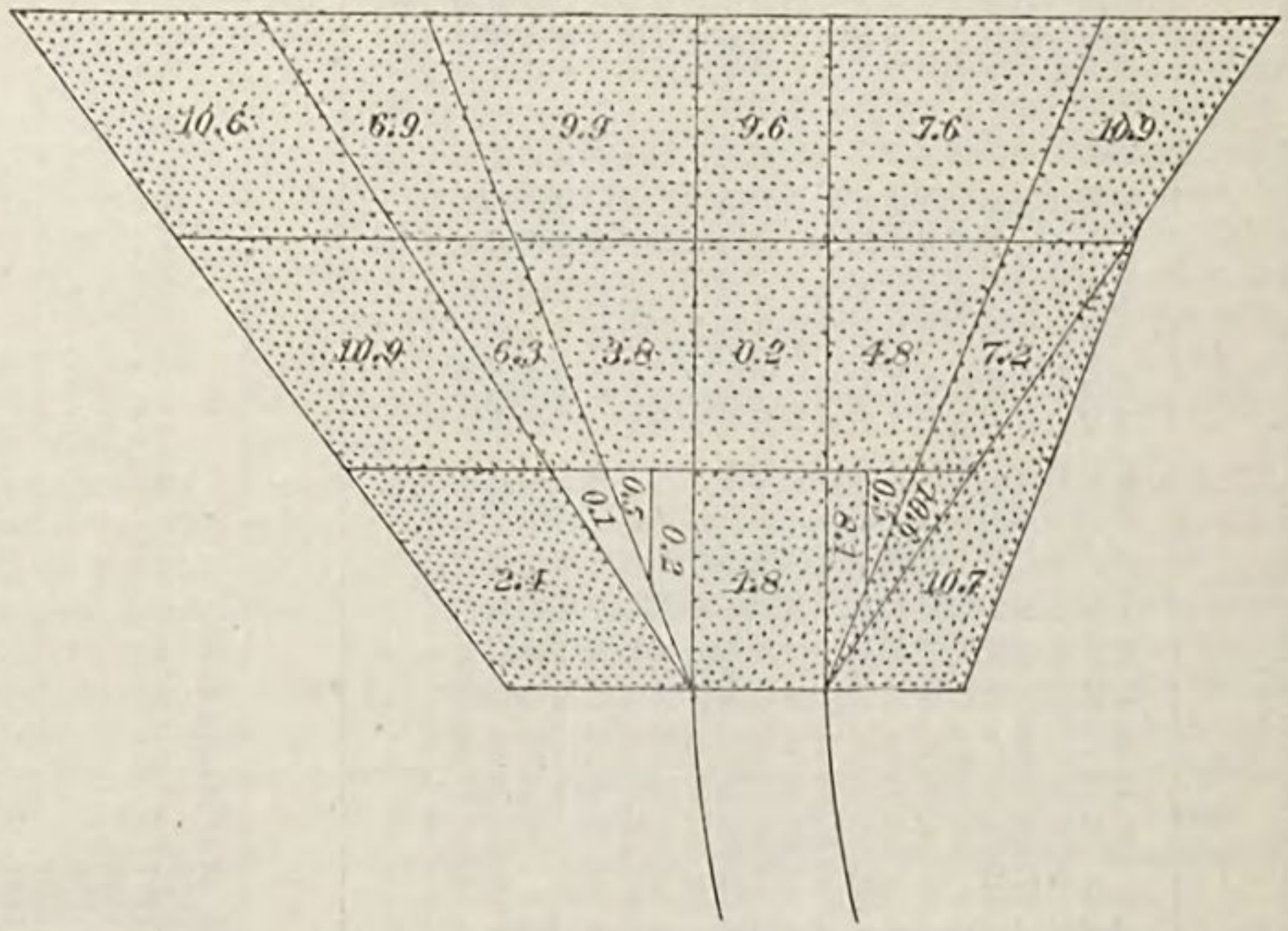
The figures in each subdivision are the differences between the mean depths in these divisions, and therefore express the amount of shoaling or deepening in each during the period under consideration. Shaded areas denote shoaling and blank areas deepening.

No. 1 gives the results deduced by comparing the depths for 1884 with those for 1885, and No. 2 compares those for 1876 with those for 1885.

No. 1. 1884 to 1885.



No. 2. 1876 to 1885.



RECAPITULATION.

From the preceding results it will be seen that the least depth throughout the channel from the main river to the Gulf of Mexico is 29.2 feet, the least width of the 26-foot channel being 220 feet.

At no time during the year, nor since August 1, 1882, have the channel measurements been found to be less than those required by law, that is, "a channel having

a navigable depth of 26 feet" through the shoal at the head of South Pass, and "through the pass itself," and "a channel through the jetties 26 feet in depth, not less than 200 feet in width at the bottom, and having through it a central depth of 30 feet without regard to width," has been maintained without the aid of dredging.

VESSELS AGROUND.

But two vessels have been aground during the year, one at the head of the Pass and one just beyond the ends of the jetties. They were drawing but 22¾ feet of water, and were found to be entirely out of the proper channel.

VESSELS OUTWARD BOUND.

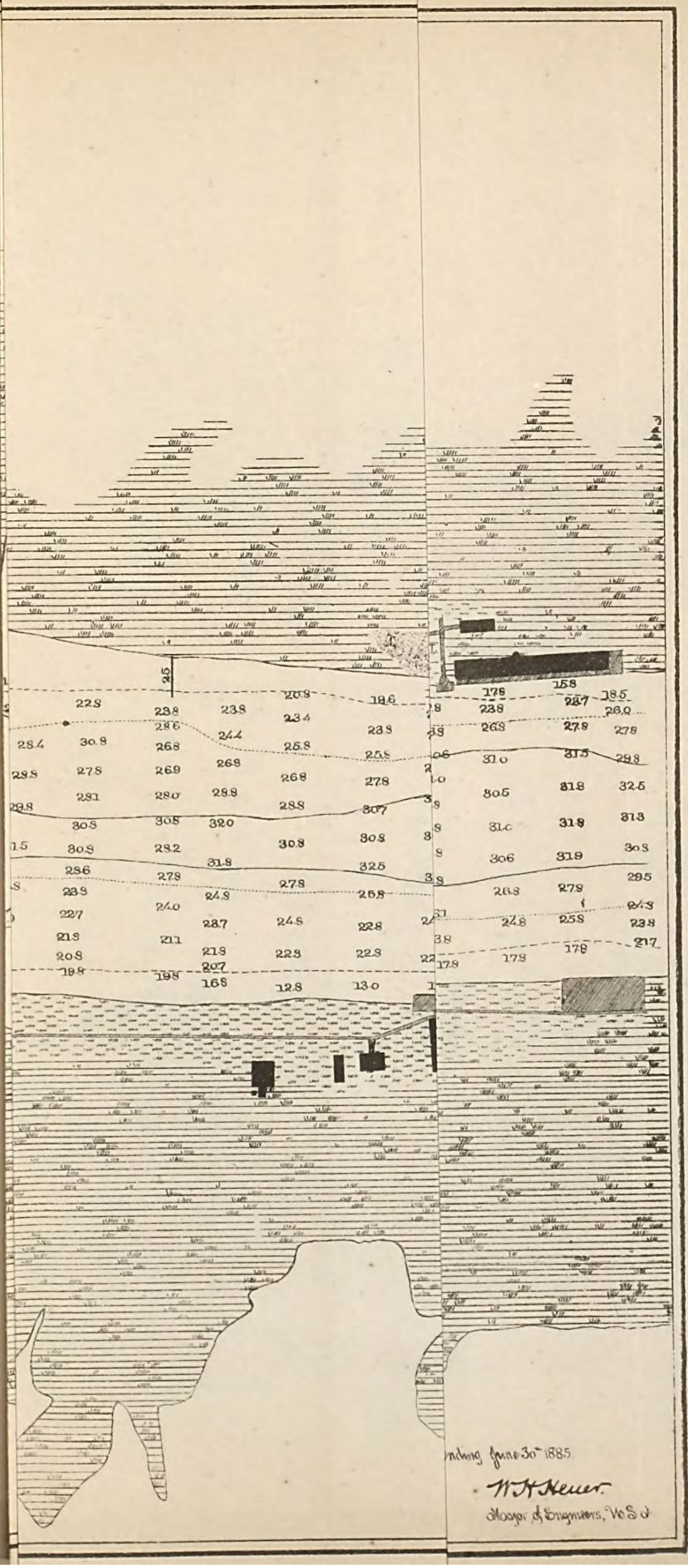
The total number of vessels which passed to sea during the year was 733; of this number 525 were steamers, 46 ships, 123 barks, 11 brigs, and 28 schooners. Thirty-seven of these drew 23 feet or more; eleven drew 24 feet or more, and the greatest draught was 24½ feet.

In conclusion, I have to commend each employé under my charge for faithful devotion to duty for several years during which they have been employed, and I am especially indebted to Recorder G. W. Lawes for valuable and efficient assistance.

Very respectfully, your obedient servant,

C. DONOVAN,
Assistant Engineer.

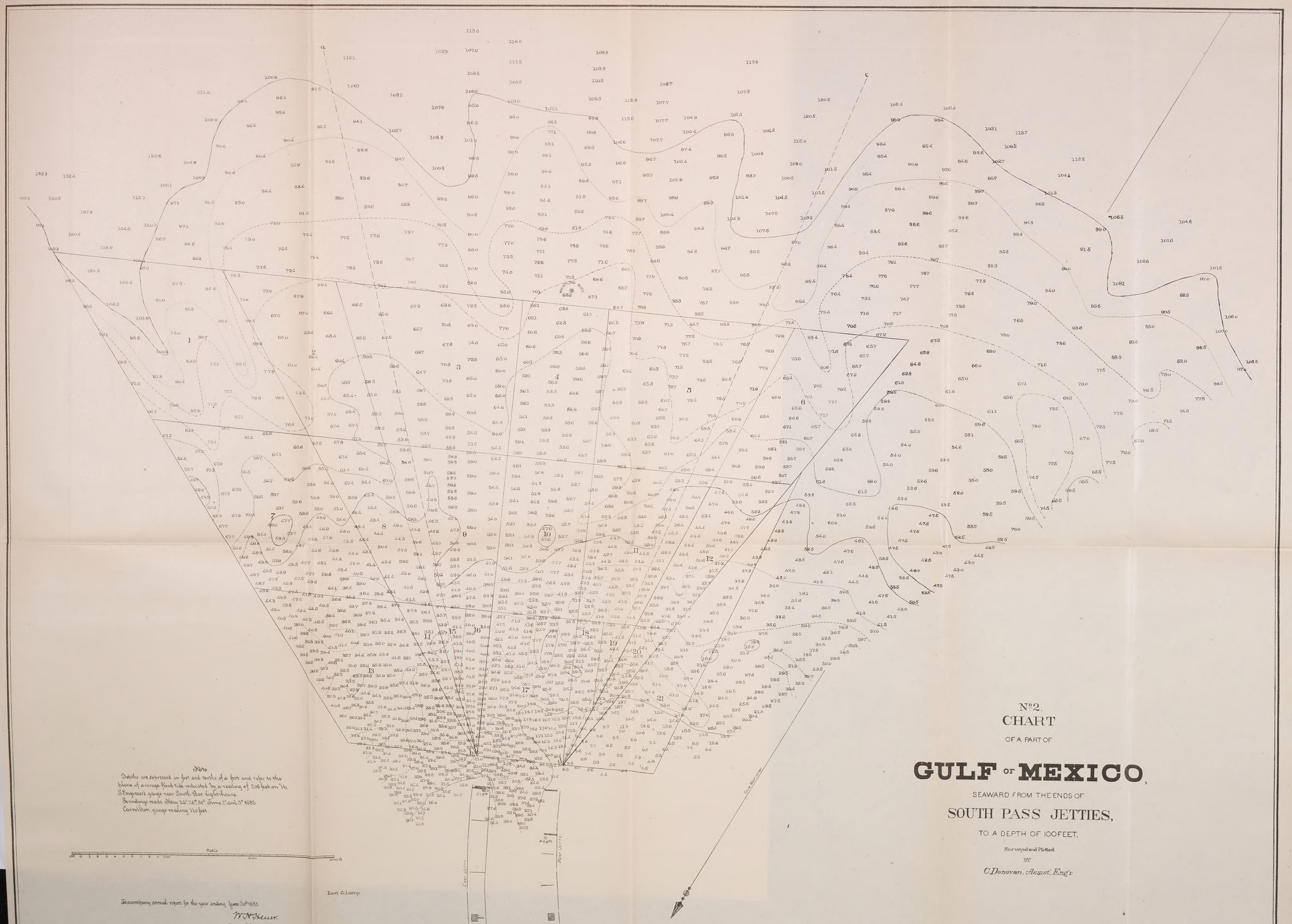
Maj. W. H. HEUER,
Corps of Engineers.



nding June 30th 1885.

W. H. Heuer.

Asstgt. Engineers, U.S.A.



Nº2.
CHART
OF A PART OF

GULF OF MEXICO,

SEAWARD FROM THE ENDS OF

SOUTH PASS JETTIES,

TO A DEPTH OF 100 FEET.

Surveyed and Plotted
BY
C. Donovan, Assist. Eng'r.

Note

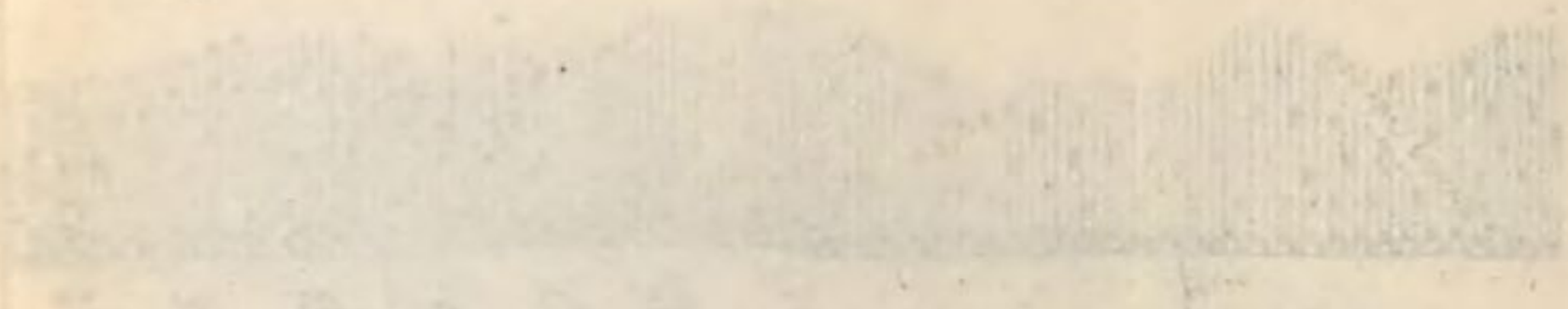
Depths are expressed in feet and tenths of a foot and refer to the plane of average flood tide indicated by a reading of 2.70 feet on the U.S. Engineers gauge near South Pass light-house.
Soundings made Oct. 25th, 26th, 30th, June 2nd, and 5th 1885.
Carrollton gauge reading 11.0 feet.

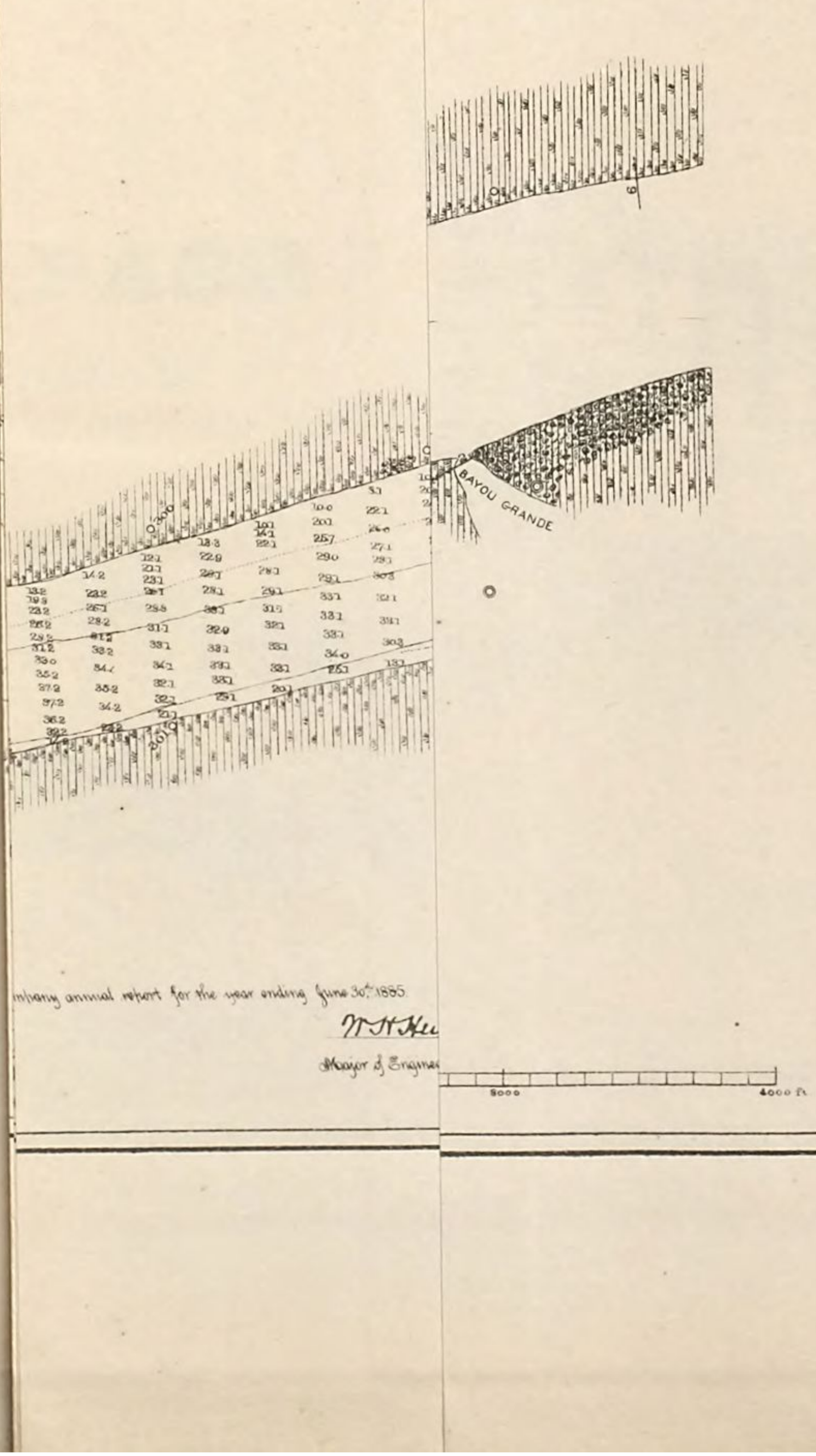
To accompany annual report for the year ending June 30th 1885

W. J. Keller
Asst. U.S. Engineers, N.O.D.

H Exl pt2 v2 491

SOUTH PASS LIGHT HOUSE.
UPPER BASE
3000
4000 ft

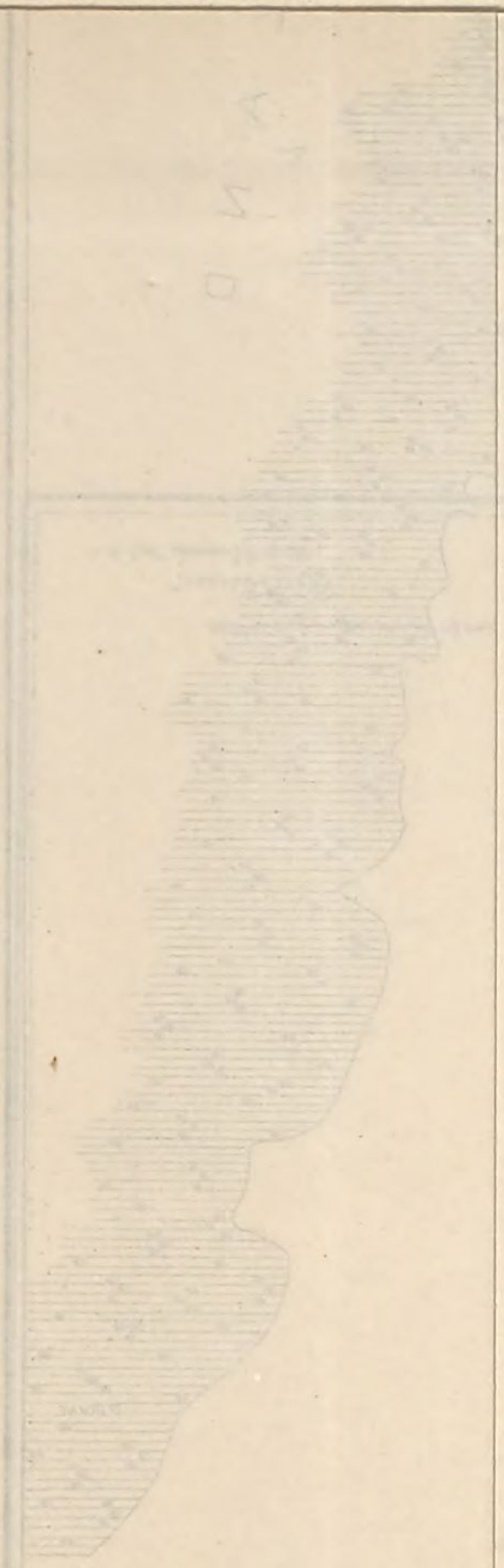


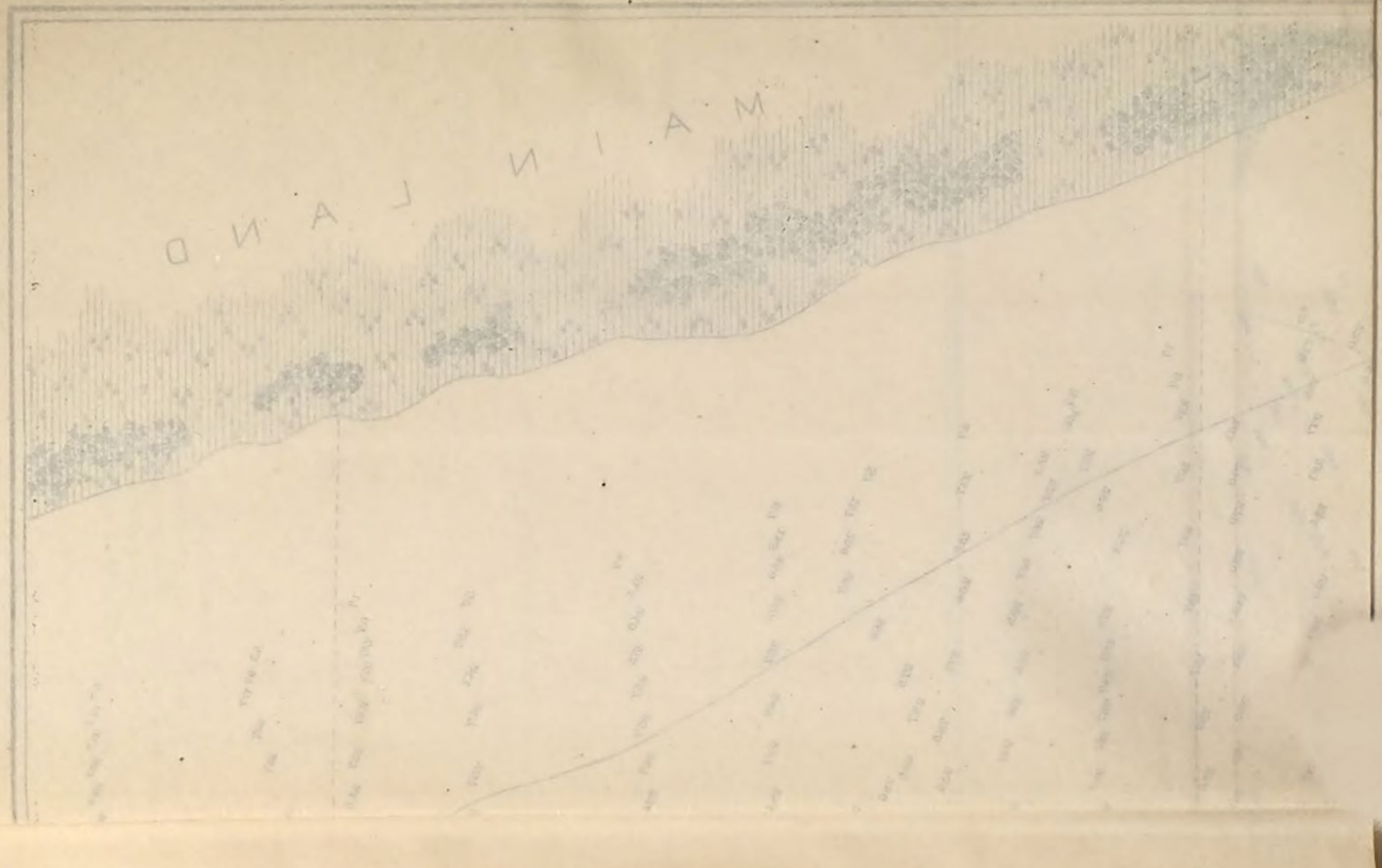


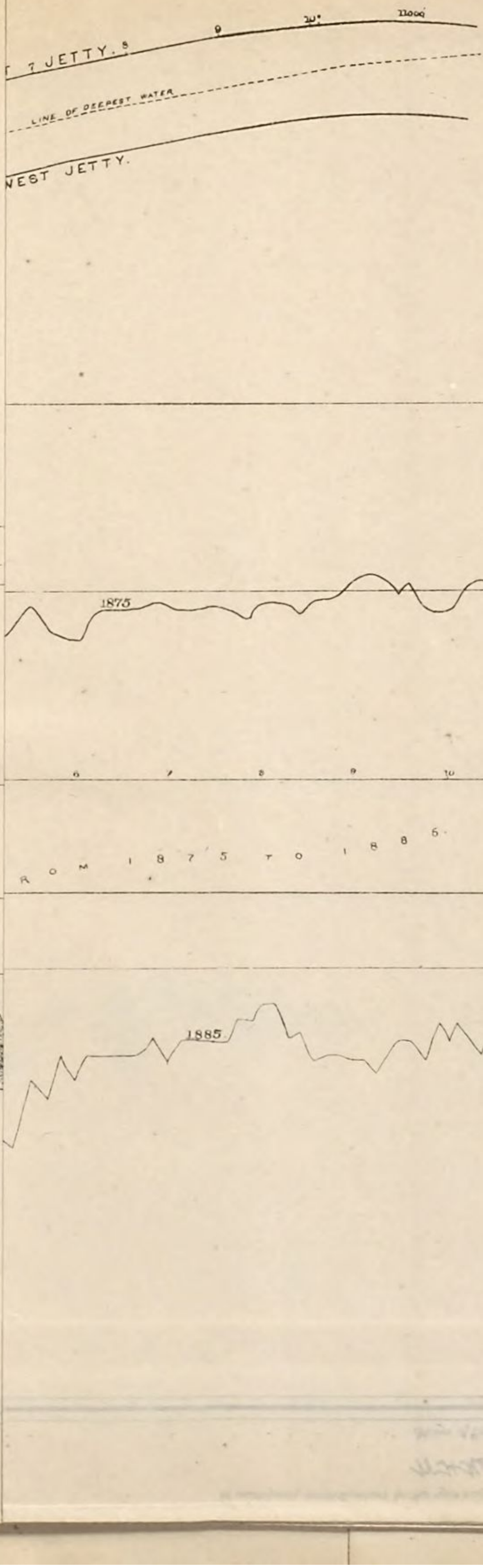
Infantry annual report for the year ending June 30th 1885.

W. H. Hu

Major of Engineers




MAINLAND


T 7 JETTY.
9
10
11000
LINE OF DEEPEST WATER
NEST JETTY.
0
5
10
15
20
1875
6
7
8
9
10
11
ROM 1875 TO 1885.
20
30
1885

Examinations and Surveys at South Pass of the Mississippi River, Major W. H. Heuer, Corps of Engineers, U.S.A. in charge.

No 7

COMPARATIVE PROFILES

ON

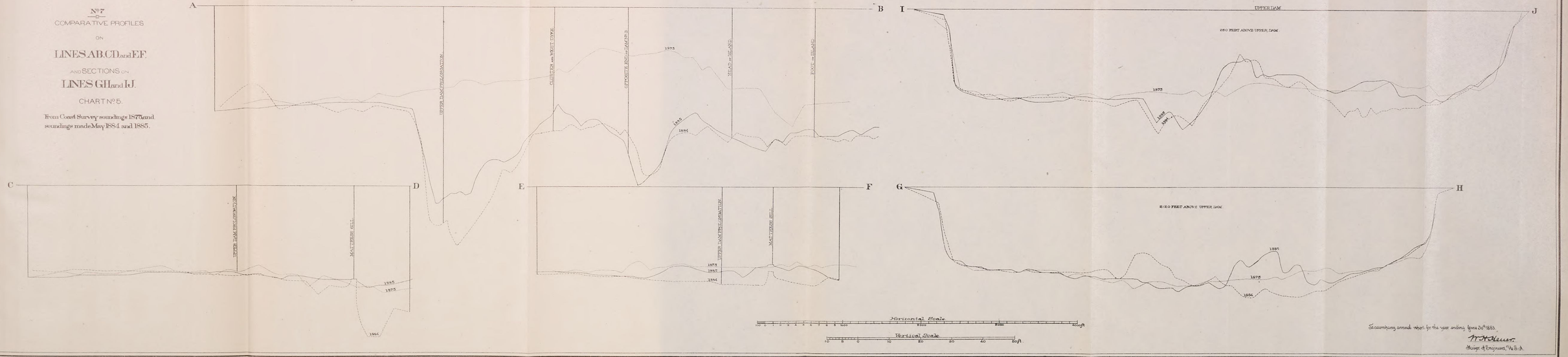
LINES AB, CD, and EF,

AND SECTIONS ON

LINES GH and IJ.

CHART No 5.

From Coast Survey soundings 1878 and soundings made May 1884 and 1885.



To accompany annual report for the year ending June 30th 1885.

W. H. Heuer

Major of Engineers, U.S.A.

H Ext pt2 v2 491

Examinations and Surveys at South Pass of the Mississippi River, Major W. H. Heuer, Corps of Engineers, U.S.A. in charge.

Diagrams

SHOWING THE ADVANCE OR RECESSION OF THE

Curves of various Depths,

SEAWARD FROM THE ENDS OF

South Pass Jetties,

from 1877 to 1885.

COMPILED BY

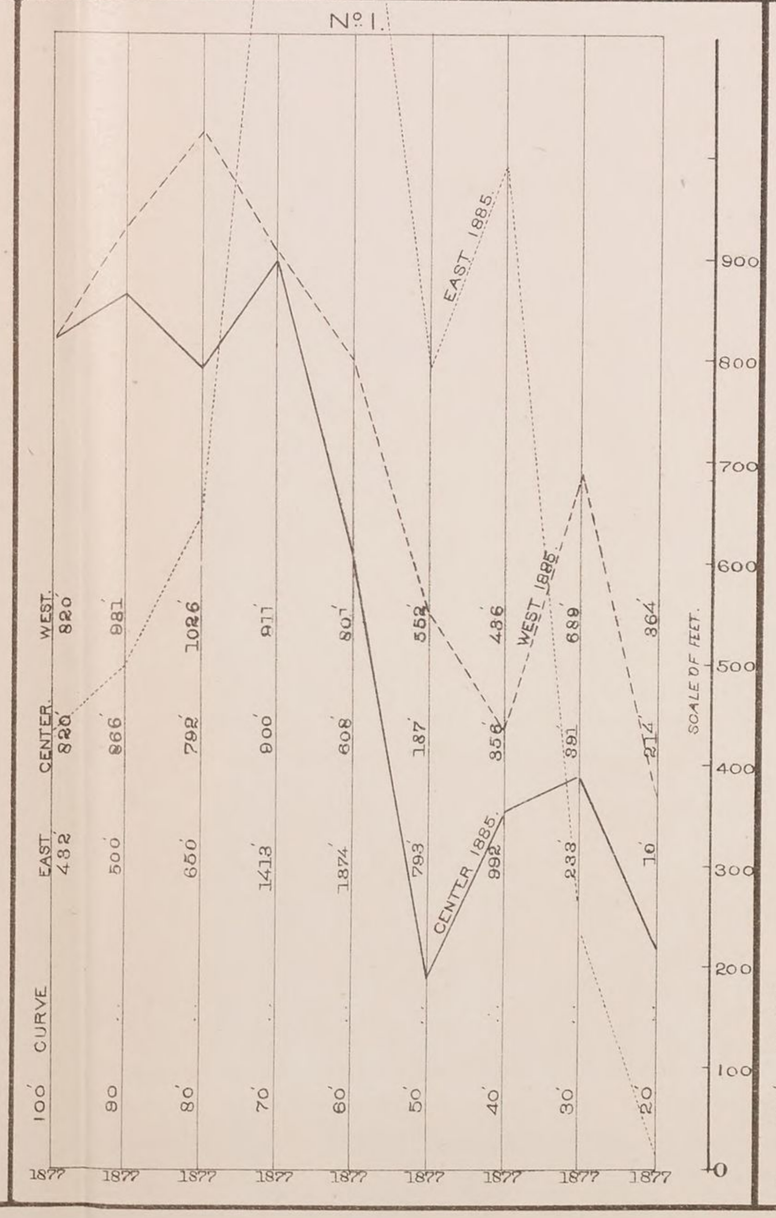
C. Donovan, Assist. Engr.

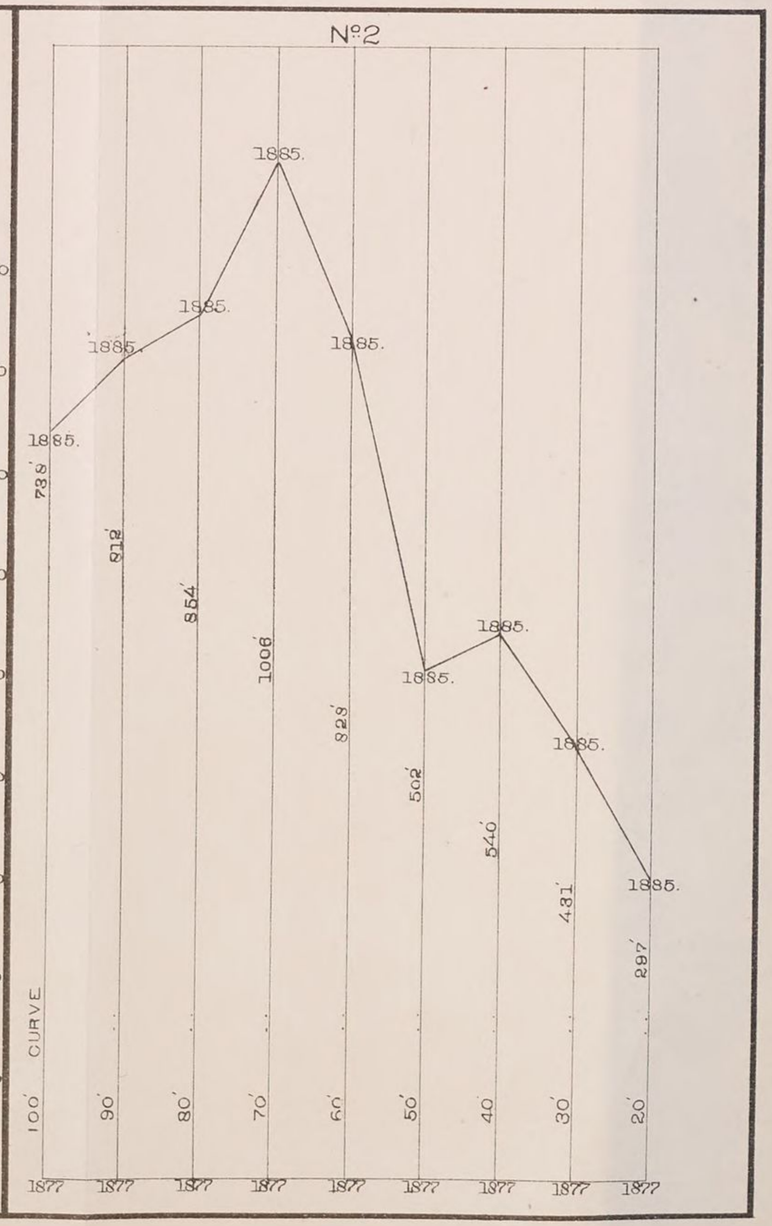
NOTE.

On these diagrams the length of each ordinate is the difference between the mean ordinate for 1877 and 1885, and, therefore, measures the amount of the movement of the various curves, between these two dates, and for this purpose the ordinates of the positions of these curves in 1877 are assumed to be zero; negative ordinates indicate recession and positive ones advance of the curve to which they pertain.

On N°1 each curve is considered in three parts and we may see how each part is affected; on N°2 each curve is considered as a whole.

Each ordinate is marked with the number of the curve to which it pertains, and the extremities of each ordinate by the years between which comparisons are made, and along the axis of ordinates is given in feet the distance that each curve has advanced or receded so that at a glance we may note the change in each curve from 1877 to 1885, and also, the amount of the same: for example, we see from N°2 that from 1877 to 1885, the 100-foot curve advanced 738 feet.





H Ex1 pt2 v2 49 1

500
400
300
200
100
200
100

APPENDIX S.

IMPROVEMENT OF VARIOUS WATER-COURSES IN THE STATE OF LOUISIANA—IMPROVEMENT OF SABINE PASS AND OF SABINE AND NECHES RIVERS, TEXAS.

REPORT OF MAJOR W. H. HEUER, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1885, *WITH OTHER DOCUMENTS RELATING TO THE WORKS.*

IMPROVEMENTS.

1. Amite River, Louisiana.
2. Tangipahoa River, Louisiana.
3. Tchefuncte River, Louisiana.
4. Tickfaw River, Louisiana.
5. Bayou Teche, Louisiana.
6 Connecting Bayou Teche with Grand Lake at Charenton, La.
7. Bayou Black, Louisiana.
8. Bayou Courtableau, Louisiana.
9. Bayou Terrebonne, Louisiana.
10. Bayou La Fourche, Louisiana.
11. Calcasieu River, Louisiana.
12. Calcasieu Pass, Louisiana.
13. Sabine Pass and Blue Buck Bar, Texas.
14. Sabine River, Louisiana and Texas.
15. Neches River, Texas.
16. Removing sunken vessels or craft obstructing or endangering navigation.

EXAMINATIONS AND SURVEYS.

17. Homochitto River, Mississippi.
18. Buffalo River, Mississippi.
19. Bayou Plaquemine, Louisiana.
20. Atchafalaya River, Louisiana, above Berwick Bay.
21. Bayou Pierre, Mississippi.
22. Natalbany River, Louisiana.

OFFICE UNITED STATES ENGINEERS,
New Orleans, La., July 15, 1885.

GENERAL: I have the honor to transmit herewith my annual reports for the fiscal year ending June 30, 1885, for the works of improvement and examinations and surveys in my charge.

Very respectfully, your obedient servant,

W. H. HEUER,
Major of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

S 1.

IMPROVEMENT OF AMITE RIVER, LOUISIANA.

This work was in charge of Maj. Amos Stickney, Corps of Engineers, until July 23, 1884, and in charge of Capt. Thomas Turtle, Corps of Engineers, from that date until February 12, 1885, and in charge of Maj. W. H. Heuer, Corps of Engineers, since that time.

The original project for improving this river was adopted in 1880, the

object being to obtain a channel of navigable width and 5 feet depth at low water, or as near that as possible without dredging, from the junction with Bayou Manchac continuously up-stream as far as the appropriation would permit. By act of Congress approved June 14, 1880, the first appropriation of $8,000 was made for this work, following an examination authorized March 3, 1879. And a contract was made in October, 1880, providing for the clearing of the river for a distance of 40 miles up-stream from the mouth of Bayou Manchac for $7,650. March 3, 1881, an additional appropriation of $5,000 was made, and the project for its expenditure provided for extending the work beyond the point to be reached by first contract. An accepted bidder for the second contract failed to furnish bonds, and the contract was therefore not completed. Work under the first contract was accepted March 15, 1883, having been before reported as finished, but upon inspection was rejected. On February, 1883, a modified project for expending balance of appropriation on the river below Bayou Manchac was approved, the work to be done by hired labor, the necessary plant to be constructed and paid for from appropriations for work of improving Tickfaw, Tchefuncte, and Amite rivers. The boats were finished, and with them and hired labor work was begun in December, 1883, at the junction of Bayou Manchac and the Amite, and continued down-stream only about 8 miles, the appropriation being nearly exhausted. This work resulted in the removal of all obstructions as far as Port Vincent, 4½ miles, below which point only those overhanging trees which were materially in the way and the snags in and near the channel were taken out, leaving many which may, by shifting their positions hereafter, become obstructions on either side of the channel. There remains on this part of the river about 8 miles on which no work has been done.

On the Amite above the mouth of the Manchac, as far up as the Comit, 17 miles of work was done by contract, but there are now so many logs, trees caved in, and other obstructions that this portion is unnavigable except for very light-draught boats.

In order to complete the work on the lower river, and go over the contract work on the upper, an estimate of $8,205 is made in the report of Maj. Amos Stickney, 1884. Major Stickney says in this report that work done by contract has not been of any apparent benefit, while that done by the Government boats and hired labor has given much satisfaction.

The value of the commerce of this river is estimated at $250,000 annually, the principal products being sugar, molasses, staves, shingles, lumber, and wood.

Should any further appropriation be made for this work it will be used in continuing the project as made.

Money statement.

July 1, 1884, amount available	$374 39
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	252 40
July 1, 1885, amount available	121 99
Amount (estimated) required for completion of existing project	8,205 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	8,205 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

S 2.

IMPROVEMENT OF TANGIPAHOA RIVER, LOUISIANA.

An appropriation was made in 1872 and was expended in clearing the river of snags, rafts, and leaning trees, over a distance of 16 miles from its mouth.

Examination and survey were authorized June 18, 1878. The survey was begun in January, 1879. The assistant engineer who made the survey found many obstructions, such as snags, overhanging trees, &c., and estimated the cost of their removal up to Connor's Bridge, 1½ miles from Amite City and 53 miles above the mouth, at $10,000. This improvement would give a clear channel 42 inches deep to a point 32 miles above the mouth, and for a further distance of 21 miles a clear channel of 24 inches.

An appropriation of $5,000 was made June 18, 1880. On September 22, 1880, agreement was made with Carl P. Segmet for clearing 34 miles for the sum of $4,750. On March 3, 1881, an appropriation of $2,000 was made for continuing the improvement. The approved project for expending this sum provided for continuing the work above the point to be reached by first contract. One bid was received on this, and being considered excessive was rejected. The first contract was reported completed in November, 1881, and the work was accepted.

On January 3, 1883, a contract was made with C. E. Cate for clearing out 7¼ miles at $235 per mile; the work was accepted late in June, 1884, having been reported twice as finished and twice rejected. On July 22, 1884, the charge of this work was transferred to Capt. Thomas Turtle, Corps of Engineers, by Maj. Amos Stickney, Corps of Engineers, in accordance with letter of instructions from the Chief of Engineers, United States Army, July 11, 1884.

On August 14, 1884, the Government plant that had been laid up at Springfield with a hired crew, proceeded in charge of a superintendent to the Tangipahoa River, under instructions to commence work where Cate's contract ended, and extend the improvement, if practicable with the funds on hand, to Amite City. The stage of water was very low, and after forcing a passage through numerous obstacles, such as stumps, sunken logs, overhanging trees, land-slides, shoals, and two wooden bridges, to within about 4 miles of the point at which it was intended to begin work, it was found impracticable to proceed any further, and under a modification of instructions the plant was dropped down to Lanier's Bridge, and the work of clearing out the stream from there down to the mouth commenced September 15, and was completed October 11, 1884.

The charge of this work was transferred to me by Capt. Thomas Turtle, Corps of Engineers, on the 12th of February, 1885, in accordance with Special Orders, No. 6, paragraph 3, January 8, 1885.

About 12 miles of the 53½ miles included in the project for the improvement of Tangipahoa River have not been touched. Major Stickney's last report recommends an appropriation of $1,700 to be made for completion, to be applied, however, in recleaning the lower river which is again obstructed. He also suggests that it might be well to consider now some plan for moving the bar at the mouth, which permits only light-draught vessels to enter. The work for the lower river has this year been done, an appropriation of $2,000 having been made July 5, 1884. It is believed that it will be useless to carry the improvement any further up-stream, and if $1,700 be appropriated by Congress in ac-

cordance with the original estimate, it will be applied to reclearing, out that portion of the river which has already been improved.

The work is not a permanent one, as obstructions are re-forming, and is purely of local importance. It is not known that any benefits have resulted to commerce since the improvements have been made.

Money statement.

July 1, 1884, amount available		$213 98
Amount appropriated by act approved July 5, 1884		2,000 00
		2,213 98
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884		2,213 98
Amount (estimated) required for completion of existing project		1,700 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		1,700 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

S 3.

IMPROVEMENT OF TCHEFUNCTE RIVER, LOUISIANA.

This work was in charge of Maj. Amos Stickney, Corps of Engineers, until July 23, 1884, and in charge of Capt. Thomas Turtle, Corps of Engineers, from that date until February 12, 1885, and in charge of Maj. W. H. Heuer, Corps of Engineers, since that time.

The project for the improvement of this river was made in 1880, and contemplated the removal of overhanging trees, logs, &c., in the channel, and the dredging of the bar at its mouth. The first appropriation of $1,500 was made March 3, 1881, and a second one for $1,500 in August, 1882; with these two appropriations the obstructions below Covington were removed and part of the unexpended balance was used for the construction of a working plant for improving the bar at the mouth, and part for the construction of a breakwater extending 820 feet into the lake. The original estimate for improving this river was $5,460, the greater portion of which was for dredging the bar at the mouth. It was thought, however, that a dredged channel over this bar could not be maintained without protecting works, and to build which would cost considerable more than the dredging. Maj. Stickney, who had his work in charge, caused a re-examination to be made in 1884, and in his report in the Annual Report of the Chief of Engineers for 1884, Vol. II, page 1269, he reports the river in good order excepting the bar at its mouth, and suggests as a method for improving the bar, to build a jetty or breakwater 2,500 feet long across the bar into the comparatively deep water of the Lake Pontchartrain, and then to dredge the channel through the bar in the hope that the jetty would prevent, or, at all events, greatly retard the refilling of the cut with sand. The estimated cost of this improvement is $20,400, and if authorized by Congress, $19,000 of this amount should be appropriated for the fiscal year ending the 30th of June, 1887, and applied to extending the breakwater, dredging the bar and removing other obstructions that may have formed since the river was cleared out. Should the improvement be made as contemplated, the protection of the mouth of the river would also enable vessels navigating the lake to use this mouth as a harbor of refuge in case of gales. The depth of water on the bar at its lowest stage (during a norther) is about 4½ feet.

The improvement thus far made has not been of any material benefit to commerce.

The report of 1884 estimates the annual value of the products carried down the river at $106,500, consisting of sugar and molasses, cotton, wool, brick, sand, charcoal, lumber, beef, and hides.

The improvement, if made, will be of local benefit only, and cannot be considered permanent, as the obstructions will eventually reform.

The work is located in the collection district of New Orleans. The nearest light-house is at the mouth of the river.

I append First Lieut. O. T. Crosby's report upon an examination of the mouth of Tchefuncte River.

Money statement.

July 1, 1884, amount available	$1,352 65
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	1,352 65
Amount (estimated) required for completion of existing project	19,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	19,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

REPORT OF LIEUTENANT O. T. CROSBY, CORPS OF ENGINEERS.

NEW ORLEANS, LA., *July* 3, 1885.

SIR: I have the honor to report as follows upon an examination of the mouth of the Tchefuncte River, Louisiana, made by me on July 1, in obedience to your verbal orders. I was assisted by Mr. C. D. Anderson.

With transit and stadia the position of the partially completed jetty was determined, and lines of soundings directed. The results have been plotted and the chart is herewith submitted. Comparing it with that made before the jetty was built, it will be seen that the lines are nearly the same. The distance between and the directions of the 6-foot curve, on the outer slope of the bar, and the inner 4-foot curve are almost exactly the same. Some changes between these in the positions of the 5-foot curve are observable, but they are immaterial. Substantially it may be said that no effect has been produced, nor could any be expected before the building of that part of the jetty which, in the original project, made a considerable angle with the inner part, and presented an obstacle to the flow of the sand moved by easterly storms. Should further work be done here, I believe an adherence to the original plan, extension of the jetty and dredging across the bar of compact sand, would be the wisest course. Some of the river men, officers of the steamer Grover Cleveland, inform me that they desire no other improvement than the placing of a beacon on the east point of the mouth, so that in dark nights they could make the channel by steering between the light-house and the beacon. They further assert that the jetty is an obstacle, inasmuch as it prevents boats from hugging the east shore during the prevailing easterly winds, thus exposing them to the danger of being driven across the narrow channel on to the west shore shoals. Steamboats drawing 5 feet have struck on the bar, and some of the large schooners in the Tchefuncte trade sometimes wait for a rise of the wind-tide to let them pass, but generally there is little complaint. Although there is as yet, so far as I can see, no reason to doubt the efficiency of the original project for obtaining increased depth across the bar, it might be wise, in view of the above reported opinions, to await an indication of expanding commerce before spending more money on the work.

As almost the entire business of the river is done with this city and through the two canals entering the old and new basins, the demand for greater draught can scarcely occur until a new line of business is established running to deeper harbors than those afforded by the canals. The jetty, 840 feet long, has stood one severe storm, losing a few of the binders which connect the piles. The bench is still in place, ann the whole structure, unless attacked by unusually severe storms, will probably remain in fair condition until the people concerned, and Congress, shall have expressed their wish in the matter.

Very respectfully, your obedient servant,

O. T. CROSBY,
First Lieutenant of Engineers.

Maj. W. H. HEUER,
Corps of Engineers, U. S. A.

S. 4.

IMPROVEMENT OF TICKFAW RIVER, LOUISIANA.

This work was in charge of Maj. Amos Stickney, Corps of Engineers, until July 23, 1884, and in charge of Capt. Thomas Turtle, Corps of Engineers, from that date until February 12, 1885, and in charge of Maj. W. H. Heuer, Corps of Engineers, since that time.

The work originated in an examination authorized by act of Congress approved March 3, 1879, a report of which, with plan and estimate of cost, was published in Report of Chief of Engineers for 1880. (Appendix M.)

The estimate, $10,230, for improvement included the branches Blood, Natalbany, and Ponchatoula rivers. The project was adopted in 1881, the object being to obtain a channel of navigable width and depth for a distance of 26 miles up-stream by clearing out obstructions such as snags, logs, trees, &c. The first appropriation of $2,000 was made March 3, 1881, and a contract entered into with Mr. Fagan on October 5, 1881. The work by contract commenced January 4, 1882, and 16 miles were reported as cleared in Report of the Chief of Engineers for 1882. In act of Congress of August 2, 1882, an additional appropriation of $2,000 was made, and the project for its expenditure provided for a continuance of contract work. But the inefficiency of the lowest bidder, and the general unsatisfactory condition of contract work of this kind in the district, caused the plan to be changed. Authority was received in the latter part of 1882 to construct, for the improvement of the Amite and Tchefuncte rivers, a wrecking plant, to be paid for out of the appropriations for the Amite, Tickfaw, and Tchefuncte rivers. Under this arrangement about two month's work with hired labor was done on this river by the new plant in the spring of 1884, and resulted in obtaining good navigation 9 miles further up-stream than schooners had before gone.

No work on the branches of the Tickfaw has been done.

The commerce of the four streams is carried by about fifteen schooners per week. The benefit to commerce resulting from the improvement of this stream is purely local. It would result in very little advantage to improve navigation any higher up on the Tickfaw, but the branches of this stream, the Blood, Natalbany, and Ponchatoula are in need of improvement, and are part of the project estimated for in 1880. It is therefore recommended that no further appropriation be made for the Tickfaw unless the money so appropriated can be applied to the branches referred to. In this event the $6,230 estimated for will complete the whole project as made.

Nothing has since been done on this river other than that necessary for the care of the plant now laid up at Springfield.

Money statement.

July 1, 1884, amount available	$38 72
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	5 00
July 1, 1885, amount available	33 72
Amount (estimated) required for completion of existing project	6,230 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	6,230 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

S 5.

IMPROVEMENT OF BAYOU TECHE, LOUISIANA.

This work was in charge of Maj. Amos Stickney, Corps of Engineers, until July 23, 1884, and in charge of Capt. Thomas Turtle from that date until February 12, 1885, and in charge of Maj. W. H. Heuer, Corps of Engineers, since that time.

On May 5, 1870, an appropriation of $500 was made for a survey and estimate of cost of improvement of Bayou Teche. The survey having been made and reported, an appropriation of $17,500 was made July 11, 1870. With this money much relief was given by removal of natural and artificial obstacles, such as overhanging trees, snags, and wrecks, between the mouth and Saint Martinville, a point about 65 miles above the mouth. The work was done by hired labor, and for a sum considerably less than that appropriated, Captain Howell, the officer in charge, having found it best to abandon some features of the original project, such as the cutting of brush along the banks.

March 3, 1879, an examination of this bayou was authorized by Congress, a report of which, together with plans and estimates, was published in Report of Chief of Engineers for 1880, Appendix M—. The improvement recommended in this report had in view the obtainment of slack-water navigation as far up as Leonville, about 109 miles from the mouth and 13 miles from the head of the bayou. Three timber locks, with needle dams, were recommended, besides removal of snags, &c. The total estimate of cost was $58,190, of which $45,000 was for the three locks and dams of 7-foot lift each. No clearing of the river for the 13 miles above Leonville was provided for, as the information obtained in the reconnaissance of 1879 led to the belief that there was no water for the passage of boats except at extreme floods. This report was submitted February 27, 1880. On June 14, 1880, an appropriation of $6,000 was made for commencement of the work. It was expended in removal of snags, overhanging trees, &c., between Saint Martinville and Leonville or Leon's Bridge. The work was reported completed in June, 1881, and after an inspection by Assistant Engineer H. C. Collins was accepted.

Subsequent examinations, and the concurrent testimony of all river men interested, leads to the conclusion that the work was done in a very unsatisfactory manner. Trees were cut down to a high-water level, leaving many dangerous stumps. The same section of the bayou would certainly have to be worked over again in any systematic improvement. March 3, 1881, an appropriation of $20,000, was made. In submitting a project for its expenditure, Major Howell recommended the making of a detailed survey before precise plans were attempted. This recommendation was approved May 12, 1881. The survey was begun in October, 1882, and completed March 13, 1883. It extended from the head to Charenton, a point about 30 miles above the mouth.

The data obtained by this survey showed that with the locks having a lift of about 8 feet each, 5 feet depth could be carried to within 4 miles of Port Barré at the head of the Teche, and that in ordinary high water this distance is also navigable. Whether it would be worth the cost to improve this reach by considerable dredging was considered questionable. While the ordinary supply was thought probably sufficient, reference is made to the fact that Spanish Lake, lying near Saint Martinville, could be readily drawn upon for an increased supply if necessary.

The position of the lower lock was assigned, in a further report on

the same survey, published in 1884, at a point about 5 miles below Saint Martinville, this to carry 5-foot navigation as far as 17 miles above Saint Martinville and 2 miles above the village of Breaux Bridge.

The original estimates were considerably changed. Each of the two locks, with accompanying dam, was estimated at $45,000. A small amount of dredging, removal of snags, &c., with 25 per cent. contingency fund, carried the total estimate to $135,625. It was recommended that the lock be of brick instead of wood. Detailed drawings were prepared, but not until *after* the above estimates were submitted, Major Stickney in his report of 1884 saying:

> The detailed plans for locks not being completed, no new estimate is presented, but it is probable that the cost of such locks as are deemed suitable for the work will increase the estimate somewhat.

The appropriation of $20,000 in 1881, was for "improving Bayou Teche between Saint Martinville and Port Barré."

On July 5, 1884, an appropriation of $6,500 was made for "continuing improvement." Captain Turtle, who assumed charge of this work July 23, 1884, in a letter to the Chief of Engineers dated January 12, 1885, recommended that of this last appropriation as much as might be needed should be applied to the removal of obstructions from the mouth up, the work to be done by the Government wrecking plant then on the Bayou La Fourche. He also recommended that additional data, such as discharge and low-water slope, bearing on the lock project be obtained and paid for from the appropriation of 1881. These recommendations being approved, the wrecking plant was transferred to the Teche in February, 1885, and has since been constantly employed there. Nearly the whole of the month of April was occupied in removing the wreck of the Chambers, the cost of the work being borne by the general appropriation for removal of wrecks. A distance of nearly 8 miles has been carefully worked over; 338 snags, 97 sunken logs and overhanging trees have been removed above New Iberia and below Saint Martinville.

The survey previously made having terminated at Charenton, Lieut. O. T. Crosby, was, in May, 1885, ordered to complete the transit-work to the mouth and carry the level line to Morgan City on the Atchafalaya, where a gauge had long been read. This work was completed June 4, 1885, and report thereon submitted. Although in the report of 1880 reference is made to a discharge measurement taken at one point, apparently by State engineers, there is as yet no reliable information as to this most important element in the problem, accurate determination of which can be made only at a low-water stage of the bayou.

The amount now available is of course too small to begin the work of lock construction, but additional study will be given the subject until Congress indicates its will in the matter. A recent personal examination of the vicinity in which the lower lock was designed to be built, and the actual and estimated cost in other sections of the United States of other locks and dams of about the same size as those proposed, make me have but little doubt of the inaccuracy of any estimate heretofore submitted as to the cost of the Teche locks. Should the locks ever be constructed, which it is hoped may not be necessary, it is certain that the estimates will have to be revised and probably largely increased. In the mean time if the bayou is to be improved by locks and dams giving slackwater navigation in the upper and now much obstructed part, it is absolutely essential that the logs, stumps, and trees standing in the bed should be removed, and this removal would almost certainly be cheaper and more satisfactory if done before the building of the locks than after. Furthermore, it is possible that when these obstructions

are removed it may be found that nothing more is necessary; in any case necessary and beneficial work will have been done, whatever system of improvement may afterward be followed. It is therefore my intention to have the wrecking plant continue its work beyond Saint Martinville, the appropriation of 1881 to be drawn upon for work done above that point.

I do not recommend any appropriation for slackwater improvement until the necessity for such improvement is made absolutely necessary, and certainly not until the snags, trees, stumps, &c., now known to be in the upper part of the bayou are removed from the bayou, and the effect of their removal is seen in the improved navigation. In the mean time, while this is being done, and for which funds are available, further study can be made of the stream, so that an intelligent and comprehensive plan and estimate for the improvement can be made.

Money statement.

July 1, 1884, amount available	$14,555 08
Amount appropriated by act approved July 5, 1884	6,500 00
	$21,055 08
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	3,049 18
July 1, 1885, amount available	18,005 90
Amount that can be profitably expended in fiscal year ending June 30, 1887 Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	18,005 90

S 6.

CONNECTING BAYOU TECHE WITH GRAND LAKE AT CHARENTON, LOUISIANA.

This work was in charge of Maj. Amos Stickney, Corps of Engineers, until July 23, 1884, and in charge of Capt. Thomas Turtle, Corps of Engineers, from that date until February 12, 1885, and in charge of Maj. W. H. Heuer since that time.

The project was adopted in 1880, the object being to connect Bayou Teche with Grand Lake, at Charenton, by a canal a little over a mile in length, 5 feet in depth, and 50 feet wide at bottom. Careful examination of the locality developed the fact that the difference in water level between the bayou and Grand Lake was variable and as much as 3 feet 4 inches, and that in the event of a narrow or 50-foot cut the current would be so rapid as to probably scour the banks, unless a lock were interposed; but that if a cut 100 feet wide at bottom be made, the lock could be dispensed with. The cost of the 50-foot canal, with lock, was estimated to be about the same as the 100-foot canal without the lock, and the latter would be very much more desirable and cost much less for maintenance.

March 3, 1881, Congress appropriated $25,000 to commence this work, the estimated cost of which was $75,000. It was shown that the cost of the work, if done by construction or purchase of plant and hired labor, would be much less than if done by contract. The amount of money available would not warrant the commencement of the work by either plan; hence the actual work of digging or starting the canal has not yet begun. The land on which the canal was to be dug and cession

of jurisdiction were given to the United States, the necessary surveys were made, the level lines run, lines located, and tide gauge observations were collated, plotted, and studied. This, together with the necessary engineering and office expenses, involved a cost of $2,899.95. Should the canal ever be cut it would be of local importance and shorten the transportation route of rafts of logs from Grand Lake into the Teche by about 75 or 80 miles.

It is not thought it would benefit steamboats plying on the Teche (the richest sugar country in Louisiana) or the planters to any great extent, for the reasons that the plantations are on the bayou, the supplies must go up the bayou, and the products of the plantations must come down the bayou, and thence by the regular rail or water routes to New Orleans. In my judgment it would be much better to defer starting this canal until it is known definitely what disposition is to be made by the Mississippi River Commission of the head of the Atchafalaya River. Any changes in this now very important stream will affect the water-levels in Grand Lake and Bayou Teche, and may require a change in the whole project for the canal.

As the money appropriated will not make a through cut, and therefore not benefit navigation or commerce to the slightest extent, and if done by contract will cost fully one-third more than if a contract could be made for the full cut, it is recommended that no work be commenced on this canal until the amount necessary to complete the same, viz, $75,000, has been appropriated and becomes available; nor is it supposed benefits to commerce will equal or approximate what the canal will cost.

Money statement.

July 1, 1884, amount available	$22,432 55
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilties July 1, 1884	332 50
July 1, 1885, amount available	22,100 05
Amount (estimated) required for completion of existing project	50,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	72,100 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

S 7.

IMPROVEMENT OF BAYOU BLACK, LOUISIANA.

This work was in charge of Maj. Amos Stickney, Corps of Engineers, until July 23, 1884, and in charge of Capt. Thomas Turtle, Corps of Engineers, from that date until February 12, 1885, and in charge of Maj. W. H. Heuer since that time. In a recent inspection of this bayou, made in April, 1885, I made notes and observations, and on them base the following report and deductions:

From the village of Tigerville to the spot where the dredge is at work, about 10 miles above, the Bayou Black has now a depth of 5 to 6 feet of tide-water; the width of this water-way varies from 45 to 100 feet.

The greater portion of this 10 miles has been worked over by the dredge, and the last 4 miles is practically a canal in the bed of the bayou which has been dug by the dredge. As fast as the digging progresses the ditch or canal which is being dug becomes filled with tide-water, but that portion of the bayou in front of the dredge is so

filled up with sediment, grass, logs, roots, and stumps, and contains so little water that at present it is impossible to float the lightest skiff.

When the examination was made in April, 1885, and resulted in a stoppage of the work, principally because the appropriation was about exhausted, I doubt if there was 50 gallons of water per minute flowing in the bayou, and a few days before this the ground in front of the dredge was so hard that it became necessary to hire four mules and a plow to break the ground so that the dredge could work. In fact, the rank, tall grass growing in the old bed of the bayou is the practical method of tracing its course.

From the point where the dredge has now stopped working to the town of Houma, via the line of the bayou (the proposed improvement), is about 14 miles in length. The bed of the bayou is filled up with mud and obstructions very nearly to a level with the roads on either side of it, so that to complete the work contemplated will yet practically require the digging of a canal 45 feet wide by 6 feet deep by about 14 miles in length.

The muck, &c., thrown out of the canal is so oozy or semi-fluid that much of it will run back into the canal, and it is probable that a pile and timber revetment may have to be built over a considerable portion of the route to prevent this.

On each bank of the bayou is a wagon road 25 to 40 feet in width, just beyond which are the fences of plantations and small farms. The muck must therefore be thrown on the road, obliterating that on one side, perhaps on both, and making either of them for the time being almost, if not entirely, impassable. When the canal or ditch shall have been completed to Houma it will enable small boats (probably flat-boats) to carry sugar and the material products of the country from the plantations bordering on the bayou from Tigerville to Houma, an extreme distance of about 24 or 25 miles.

It is said that upwards of twenty-five years ago a steamboat once ran in this bayou up as far as the town of Houma. This may occur again if the canal be dug as far as Houma, but one can judge of th character and capacity of a steamboat that can run in a ditch 40 feet wide and no place in this ditch where such a boat can turn around, and it is also probable that should a steamboat be put on this route, the wash of her waves would again cause the soft banks to slough and cause the closure of the canal.

The report of the examination of this bayou, made in compliance with river and harbor act of June 14, 1880, under direction of Major Howell, in 1881, and printed in Annual Report of Chief of Engineers for 1881, Vol. 2, page 1288, well describes the condition of the bayou and contains the estimate and the project for the improvement now in progress.

With these facts before them, Congress, in 1881, made the first appropriation, $10,000, for the improvement of the bayou; this and subsequent appropriations, aggregating $25,000, have been made with which work has been pushed, and the result is as stated, a ditch or canal about 10 miles long, from 40 to 100 feet wide, and varying from 5 to 6 feet in depth. The estimate for completing this improvement by Major Howell, in 1881, was $47,520; of this amount nearly $25,000 has been expended, of which about $4,500 was used in part payment for the building of a dredge-boat now in use in cutting this canal. This would leave $20,000 expended in actual dredging about 10 miles of bayou, a considerable portion of which was already open bayou, and between 14 and 15 miles of bayou; yet to be opened, the average quantity of material to be removed in each mile of cutting I estimate to be nearly

double what it was in the preceding 10 miles already opened and therefore estimated to cost nearly twice as much, or $4,000 per mile. As there are yet about 14 miles of cut to be made, the estimate for completing this cut should be $14 \times 4{,}000 = \$56{,}000$. This, together with the $25,000 expended, would be $81,000, an excess of $33,480 over the original estimate for completing the work. It is barely possible that this estimate for completion may be too great, but when the sunken, imbedded logs, stumps, roots, thrown up by the dredge all along the embankment are seen, no prudent engineer would submit a smaller estimate, and I feel warranted in saying that no contractor would make a contract to do the work required even on this estimate. Moreover in pushing the work to advantage the engineer in charge of this improvement has never estimated less than $10,000 to be necessary for any one year's work.

Congress, July 5, 1884, appropriated $5,000. Such an amount entitles a dredge and crew to work five or six months; then the funds become exhausted and the balance of the year, the dredge is laid up, deteriorating for want of use, and is in charge of a watchman at a considerable expense, in addition to the unsatisfactory work accomplished due to want of funds.

The work drags slowly along, and the longer the delay in the final completion of the work the more certain is the canal dug in the rear of the dredge to refill with sediment, the result of washings after heavy rains as well as grass and vegetable matter.

The bayou, as far as opened (10 miles), is of very little use to commerce. It simply enables the products of the few plantations on the bayou now open to be floated on flat-boats as far as Tigerville, and thence be transferred by rail 66 miles to New Orleans, or if preferred these products could be transferred to New Orleans by water via Bayou Chêne, Bayou Boeuf, and the Atchafalaya and Mississippi rivers to New Orleans, a distance by water of about 400 miles.

Suppose now that the additional 14 miles of cut was completed into the Bayou Terrebonne, the result would be that planters along the Black and Terrebonne could use this canal to get their products to the railway and about 70 miles of railway carriage to New Orleans or over 400 miles of water transportation to New Orleans by the nearest present available route. It is reasonable to suppose that the railway rates for carrying freight less than 70 miles should be less than that of water routes nearly six times as long. The advantage to the planter in having the improvement made is therefore simply the saving in cost and time to him in his transportation or hauling his product from his plantation by wagon or by canal to the nearest railway station. On or near the Bayou Black and 25 miles apart are two railway stations, Tigerville and Houma; therefore the longest haul to nearest station would be $12\frac{1}{2}$ miles, or an average haul of $6\frac{1}{4}$ miles. Is the Government justified in cutting a canal, for that is just what is being done in "Improving Bayou Black," the lowest estimated cost of which is $47,520, for the sake of saving to the planter the difference between $6\frac{1}{4}$ miles of wagon and canal transportation?

The improvement at its best is simply a local one and only benefits the people living on or near the bayou, and can in nowise be considered a public necessity, but, as it has been begun by authority of Congress and $25,000 has been spent on it, if the work were now stopped the greater portion of this money would be wasted. It is therefore assumed that the work will be continued to completion, and in this event no less than $10,000 should be appropriated for the fiscal year ending June 30, 1887.

It must also be distinctly understood that while I do not recommend that Congress appropriate $10,000 for the year's work, because it will benefit the Government or the people in and near Bayou Black to this extent, it is simply because, in an engineering point of view, this is the least amount of money that can be advantageously expended in doing economical work, provided Congress intends to continue this improvement.

Money statement.

July 1, 1884, amount available	$3,036 93
Amount appropriated by act approved July 5, 1884	5,000 00
	8,036 93
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	7,609 25
July 1, 1885, amount available	427 68
Amount (estimated) required for completion of existing project	56,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	10,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

S 8.

IMPROVEMENT OF BAYOU COURTABLEAU, LOUISIANA.

This work was in charge of Maj. Amos Stickney, Corps of Engineers, until July 23, 1884, and in charge of Capt. Thomas Turtle, Corps of Engineers, from that date until February 12, and in charge of Maj. W. H. Heuer, Corps of Engineers, since that time.

The following is a list of appropriations made for improving the bayou:

June 14, 1880, appropriated	$7,500
March 3, 1881, appropriated	7,500
July 5, 1884, appropriated	4,000
Total	19,000

During the past fiscal year a quarter-boat and a flat-boat containing a pile-driver were built for use on this bayou; when these were completed the water in the bayou was so high that it was useless to attempt any work at repairing the dams or building new ones in any of the outlet bayous.

The original project made for the improvement of this bayou in 1879 was to improve these navigable condition of this stream by removal of a bad bar near its mouth known as Little Devil Bar; and this was to be effected by closing side outlets from the main bayou by means of dams as might be necessary to concentrate the water which would escape from these outlets onto the bar, and thus scour it away, or at all events keep a channel through it, thereafter to make slack-water navigation to Fort Barré, and above in the stream by means of locks and dams.

The estimated cost of the whole work was $40,000, and this was afterwards modified and increased so that the estimate reached $78,500.

As appropriations became available, several dams were built across some of the outlet bayous, and the result was a very marked deepening of the bar at the mouth of the bayou, by as much as 3 feet in two days.

One of these dams was afterwards reported cut by the swampers, and the result was that in 1884 the bar, immediately after the dam had been cut, shoaled 4 feet in vertical height. This bar is caused by the backwater from Atchafalaya, and since this stream has increased so much in size in the last few years it has thrown an increased quantity of water into the Courtableau; this has found an outlet through the other bayous running out of the Courtableau, and the consequence is an enlargement of each of these smaller bayous which had not yet been closed, and as no effective work on Little Devil Bar can be done until these outlet bayous are closed, it is plain that the larger the outlets the more it will cost to close each of them. It is also certain that it is not of much use to improve the navigation of the bayou higher up until the bar at the mouth can be controlled; hence Captain Turtle, lately in charge of this work, after a personal examination of this stream, made a project which was approved by the Department in Washington for closing these bayous so far as the money available would permit. His report and project are appended.

The outlets yet to be closed are the Jurommon, Mamzelle, Big Fordoche, English, and Little Fordoche, and it is thought that to do this work effectually will cost about $16,000.

I do not recommend any appropriation to commence lock construction until all the run-out bayous have been closed. The statement of Mr. Collins in his report to Major Stickney, in charge of this work, throws light on this subject and is appended.

It may be possible with the plant now available, when the water in the bayou falls somewhat, to build one or two of the dams required with the money available. The other dams will have to await commencement until money is appropriated.

The commerce of the bayou is very large and supports a line of steamboats. They can always run when there is sufficient water on Little Devil Bar.

Money statement.

July 1, 1884, amount available	$2,687 81
Amount appropriated by act approved July 5, 1884	4,000 00
	6,687 81
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	2,795 71
July 1, 1885, amount available	3,892 10
Amount (estimated) required for completion of existing project	12,107 90
Amount that can be profitably expended in fiscal year ending June 30, 1887	12,107 90

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

REPORT OF MR. H. C. COLLINS, ASSISTANT ENGINEER.

NEW ORLEANS, LA., *June* 15, 1884.

SIR: I have the honor to submit the following report on improvement of Bayou Courtableau, Louisiana:

No work has been done on this work for the year past, as the amount on hand at the beginning of the year was considered too small to warrant beginning after the fall of the water in 1883. Since any work was done there have been two very high-water years, and since the survey great changes have taken place from the enlargement of the Atchafalaya and the increasing amount of water passing down through the swamps west of the Atchafalaya. The bayous which bring water into the Courtableau from the north and those which take it out on the south have very greatly enlarged from the greater current passing. The dam of Little Fordoche is gone down to nearly

low-water level. It was probably cut. The dam in Big Fordoche is whole yet, but the water yet covers all the low land on both sides of the Courtableau near Little Devil Bar, and the soundings when I was there in March showed that the sand of the bar had filled in so as to bring the top of the bar up to within about 3 or 4 feet of the level of the land on the bank. This is about 4 feet higher than it had been before, and should there be no current, both streams falling together, the bar would be dry, with a fall of about 7 feet in the Atchafalaya.

Unless there should, as in 1872, be a fall of the Atchafalaya and a subsequent rise in the Courtableau to sweep out the bar, navigation will stop entirely unless resort is had to dredging.

There is no doubt about the means of removing the Little Devil Bar being, as before reported, the entire closure of all the run-out bayous on the south side, but owing to stoppage of work that before done is gone and the channels have washed out larger, so it will cost more to close them than it would before have cost. The amount available, with that asked for in 1883, will no longer be enough to do the work, and it will be necessary to use at least $5,000 more now or at least $13,000 in addition to that now available.

Were it possible to do this work at any time of year it would not cost so much, but it must be done at low water—between July and December—when little more than half the average amount of work can be expected from men, owing to swamp fever, which follows the overflow.

Construction of a lock on this bayou must wait until entire closure of these bayous has caused the removal of Little Devil Bar.

Works on the Atchafalya may by that time cause a great change in condition of the whole valley. Closure of these run-out bayous must be done in any case, whatever the decision of the Mississippi River Commission may be on the Atchafalaya and Red River problem; but any work after these closures will depend on their plan for Atchafalaya.

The commercial importance of this work is very great. With the work done on the original plan so there would be good slackwater navigation to the Lamoui, as the business would take four or five round-trip steamers per week from New Orleans, instead of one as at present.

Yours, respectfully,

H. C. COLLINS,
Assistant Engineer.

Maj. AMOS STICKNEY,
Corps of Engineers, U. S. A.

PROJECT OF CAPTAIN THOMAS TURTLE, CORPS OF ENGINEERS.

OFFICE UNITED STATES ENGINEER,
New Orleans, La., November 28, 1884.

GENERAL: In compliance with request in letter from your office, dated July 16, 1884, I have to submit the following project for the expenditure of the appropriation made by the act of July 5, 1884, for the Bayou Courtableau, Louisiana, after personal examination.

As may be found in the previous reports, the chief obstruction to navigation is a bar about 1 mile from the lower end of the Atchafalaya River. This bar is formed by deposits from the waters of the latter, which during the seasons of floods pass up the Courtableau for a certain distance.

In the lower 12 miles of the Courtableau a number of bayous at various stages draw off its waters discharging to the southward. When the Atchafalaya is relatively the higher a portion of its discharge passes out of its channel into the Courtableau and then to the southward through a number (depending on the excess of the stage in the Atchafalaya) of these bayous, which thus become practically side outlets of the latter. This southern bank of the Courtableau is in its lower portion and for considerable distances lower than the banks of the Atchafalaya. So that the floods of this latter find an outlet into the Courtableau and over its south bank as well as through the bayous mentioned.

Both banks of the Courtableau in this lower region are higher than at some distance away. The waters of the Atchafalaya then rising above the Courtableau banks and impeded by this bar overflow to the north to return to and cross the Courtableau further up.

The depression of the Atchafalaya waters at this locality results in the formation of this bar. A bar has always existed here, but in late years the enlargement of the Atchafalaya and the greater height of its floods, with the increased quantities of material scoured and carried away, here increased this bar both in height and extent.

It will be seen that the treatment decided upon for the head of the Atchafalaya has a direct influence upon the question here presented, though a consideration of that cannot enter this project.

If present causes be permitted to continue, it may be imagined that the enlargement of the south side bayous of the Courtableau will result, and finally those above the bar will become so great as to discharge all its waters except at stages higher than ordinary, so that the scour upon this bar which now takes place on the relative rise of the Courtableau or on the fall of the Atchafalaya may be much decreased or even cease, and that consequently a practicably navigable connection between the two waters may be cut off, and this at the present time and stage is actually the case, and freight has to be transferred across the bar a distance of about 1½ miles.

The conditions being as here stated, it is impracticable to entirely obliterate this bar. The most effective method would require the preventing of all overflow by the south bank of the Courtableau. Because of its cost relative to the interests to be served this is at this time impracticable, and amelioration is all that can be attempted. The project heretofore proposed and approved by the Chief of Engineers (as shown by printed reports) of so closing the run-out bayous on the south side as to limit the stage at which the discharge through them will continue is now recommended. This stage is about 10 feet above low water in the Atchafalaya. The crest of the bar is now nearly 8 feet above that plane. This closure has heretofore been attempted by means of brush pinned down by small piles and puddled or loaded with clay, and little success has attended it. There is no material accessible to weight mattresses, by which means closure could be assured undoubtedly. I propose to use piling and sheet-piling driven deeply, and secured from scour as well as practicable by brush-mats above and below. For weighting these I think I can procure brickbats in sufficient quantity. The planks of such a dike will be the weak points. I propose to extend these pile and sheet-pile dikes well into the banks, and as an experiment to pave the banks with bricks (as flanks of dams are secured elsewhere by means of stone) in two layers, the lower laid flat as in ordinary sidewalks, and the upper on edge, and laid in cement. This paving will be secured at its foot by a pile and sheet-pile support. The actual quantities are small; the extent of the work must be left to the judgment of the assistant, and it is in my opinion impracticable to prepare proper specifications for a contract.

I therefore report that it is more economical and advantageous for the Government that the work should be done by hired labor and the purchase of material in open market, and I recommend that this be done.

Very respectfully, your obedient servant,

THOMAS TURTLE,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

S 9.

IMPROVEMENT OF BAYOU TERREBONNE, LOUISIANA.

This work was in charge of Maj. Amos Stickney, Corps of Engineers, until July 23, 1884, and in charge of Capt. Thomas Turtle, Corps of Engineers, from that date until February 12, 1885, and in charge of Maj. W. H. Heuer, Corps of Engineers, since that date.

No work has been done in this bayou during the past two years owing to a lack of funds.

An examination of this stream was ordered by Congress in 1879. A project for improvement was made in 1880, at an estimated cost of $18,800, of which about $15,000 was to be for dredging, the balance for removing logs, clearing of trees, &c.

The commerce to be benefited by the improvement, principally sugar and molasses, was estimated at an annual valuation of $958,750. In 1880 an appropriation of $10,000 was made; with this a dredge was hired, and work was commenced 23½ miles below Houma, La., working up-stream. In March, 1881, $8,800 more was appropriated.

The hired dredge improved about 8½ miles of channel, and in 1881 stopped work about 15 miles below Houma. The examination for improving the bayou was made during high water, and was found to be altogether too small in amount, as during low water it was seen that the bayou was little more than a ditch. The estimate for improvement was accordingly increased by Major Howell, the officer then in charge, by $20,000. With part of the money available from money appropriated for this work and part from Bayou Black appropriation, a dredge was built to continue this work. The Terrebonne appropriation paid $5,262.70 toward the building of the dredge. In August, 1882, $7,000 more was appropriated for continuing this work, and in September, 1882, work with the new dredge was commenced and continued to within 10½ miles of Houma, when the funds became nearly exhausted and further work had to stop.

No appropriations have since been made, and consequently no further work has been done. The channel was originally dredged to a depth of 6 feet, but nearly every plantation on the bayou has ditches draining into it; these cause deposits in the bayou, and opposite these numerous ditches it has again shoaled up until the depth is only about 4.8 feet.

One or two very small steamboats run up to Houma when there is any business for them, and the project was to carry the improvement up to Houma, there connect with an old abandoned canal, about a mile long, now dry, with wagon-roads crossing each end of it, which canal formerly connected with the Bayou Black. Should this and the Bayou Black work ever reach the opposite ends of this short canal, which was about 33 feet wide, then it was hoped this would be deepened and enable the tides to flow regularly through both bayous and the canal, and maintain by its flow a better depth of water by preventing the rapid growth and accumulation of grass and vegetable matter.

Should any further appropriation be made the work of dredging will be continued toward Houma. It is thought the work can be completed to this place for the $13,000 estimated for in 1881–'82. If this improvement, and that of Bayou Black in connection therewith, be completed, they will be reasonably permanant and of some local benefit to this section of the State of Louisiana.

The commercial value of the products raised on the Bayou Terrebonne is estimated when the crops are good at a little less than $1,000,000 per

year, and it was reported prior to a year ago that the improvement had occasioned competition and a reduction of freight rates in this locality of about 25 per cent.

Money statement.

July 1, 1884, amount available	$4 92
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	4 92
Amount (estimated) required for completion of existing project	13,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	13,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

S 10.

IMPROVEMENT OF BAYOU LA FOURCHE, LOUISIANA.

This work was in charge of Maj. Amos Stickney, Corps of Engineers, until July 23, 1884, and in charge of Capt. Thomas Turtle, Corps of Engineers, from that date until February 12, 1885, and in charge of Maj. W. H. Heuer, Corps of Engineers, since that time.

The original project for this work was adopted in 1879, from surveys authorized by act of Congress March 3, 1873 (see Report of Chief of Engineers for 1874, Appendix S 5), the object being to improve low-water navigation of the bayou by removal of obstructions, such as snags, wrecks, raft-heaps, cutting of trees, &c., which obstructed navigation.

On account of high water, operations were suspended December 31, 1881, and resumed September 21, 1882. From this time till January 31, 1883, the work was carried on steadily to a point 30 miles below Lockport, when, the funds being nearly exhausted and the water getting too high, the plant was taken to Lockport and laid up.

In the river and harbor act of August 22, 1882, provision was made for a survey of this bayou. A preliminary report on this was forwarded on August 30, 1882, and in Department letter of April 24, 1883, it was directed that the survey should be made.

No work was done during the year ending June 30, 1884, the balance of available funds being too small to permit anything more than the payment of a watchman for the care of the boats.

On August 25, 1884, an amended project was submitted by Captain Turtle for continuing work downward from where it had been suspended the previous year, and authority was received from the Chief of Engineers, under date of September 1, 1884, to carry on the work as recommended.

The work of overhauling the plant at Lockport was immediately commenced, and work was resumed September 22, 1884, and continued until January 15, 1885, when it was again stopped on account of high water, and the plant ordered back to Lockport and the crew discharged, except the suboverseer and cook, who were retained for further service on Bayou Teche. The plant was at the same time placed under the direction and orders of First Lieut. O. T. Crosby, Corps of Engineers. No work has since been done on this bayou, except the taking of gauge readings at Orange City, La. The commerce of Bayou La Fourche has been greatly benefited, the number of vessels having steadily increased as the obstructions were removed. Before any work of improvement the bayou was so obstructed with snags, logs, and wrecks from its head

at Donaldsonville to a point about 22 miles below Lockport, that during the low-water season flat-boats and luggers drawing about 2 feet were the only kinds of vessels able to navigate. In some places, especially between Raceland and Lockport, a distance of 7½ miles, even this was difficult, the luggers having to lower sail and cordelle. But since the removal of obstructions flat-boats and sailing-vessels of even greater draught have passed up and down without difficulty. During eight months of the year, when the water is high, the bayou is navigable for large-size steamboats.

COMMERCIAL STATISTICS.

The commerce of Bayou La Fourche is sufficient to support a line of steamers. Both banks are in a high state of cultivation, principally large sugar and rice plantations. It is not uncommon for the crop of one plantation to be worth from $50,000 to $100,000.

The work is located in the collection district of New Orleans. The nearest light-house is on the eastern end of Timbalier Island.

No money is asked for fiscal year ending June 30, 1887.

A study is being made for the permanent improvement of this bayou, but as the surveys are incomplete no detailed estimate or project can yet be submitted.

Money statement.

July 1, 1884, amount available	$0 76
Amount appropriated by act approved July 5, 1884	5,000 00
	5,000 76
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	3,756 21
July 1, 1885, amount available	1,244 55

S 11.

IMPROVEMENT OF CALCASIEU RIVER, LOUISIANA.

This work was in charge of Maj. Amos Stickney, Corps of Engineers, until July 23, 1884, and in charge of Capt. Thomas Turtle, Corps of Engineers, from that date until February 12, 1885, and in charge of Maj. W. H. Heuer, Corps of Engineers, since that time.

The original examination of this river was made only down to Lake Charles. A subsequent examination was made of the lower part of the river at its mouth in Lake Calcasieu, report of which will be found in Annual Report of Chief of Engineers for 1883, Appendix Q.

It is believed that any improvement of the river should commence at the mouth. Several projects have been made, but, not proving satisfactory, none has yet been submitted to the Department. As the amount appropriated for the river previous to the recent act of Congress ($10,000) was less than one-third of the amount estimated for the work at the mouth, and the work that could be done for the amount available would not produce the effect of deepening the channel over the bar, it was considered as well to delay the commencement of operations until a sufficient sum was provided for producing an appreciable improvement.

The improvement of that part of the river above Lake Charles is of so much less importance to the general navigation that no expendit

should be made that would leave the work at the mouth unprovided for. The act of Congress approved July 5, 1884, makes an additional appropriation of $6,500. With the total sum of nearly $16,500 now available it is probable that effective work may be done at the mouth of the river.

To make a permanent channel through the bar, and to provide a navigable channel of at least 8 feet up to Lake Charles, beside removing obstructions above Lake Charles, it is estimated that an additional amount of $29,580 will be required. The work originated in an examination authorized by act of Congress approved June 14, 1880. A report, with plan and estimate of cost of improvement, was published in Annual Report of Chief of Engineers for 1881, Appendix M 15. A further examination was made, report of which was published in Annual Report of Chief of Engineers for 1883, Appendix Q.

Work will be commenced on the bar at Calcasieu Pass as soon as the question has been decided whether or not money appropriated for the improvement of the river can be used on this bar. As bearing on this subject I submit report of Capt. Thomas Turtle, Corps of Engineers, U. S. Army.

Money statement.

July 1, 1884, amount available	$9,791 09
Amount appropriated by act approved July 5, 1884	6,500 00
	16,291 09
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	35 63
July 1, 1885, amount available	16,255 46

PROJECT OF CAPTAIN THOMAS TURTLE, CORPS OF ENGINEERS.

NEW ORLEANS, LA., *December* 8, 1884.

GENERAL: In reply to circular letter from your office dated July 16, 1884, calling for projects for expenditures under the act of July 5, 1884, making appropriations for work of river and harbor improvement, I have the honor to present the following, relative to the Calcasieu River, Louisiana:

The act of July 5, 1884, appropriates $6,500, to which sum is added the sum heretofore appropriated to be used at the mouth of the river. The sum now available from appropriations for this river is the balance left from the following appropriations:

Act of March 3, 1881, improving the Calcasieu River from Phillip's Bluff to its mouth, $3,000; act of August 2, 1882, improving the Calcasieu River (no locality mentioned), $7,000; and the act of July 5, 1884, referred to above, $6,500—a total of $16,500; the balance being $16,291.09.

The sum which is directed to be added as heretofore appropriated to be used at the mouth of the river, I cannot identify, unless it be the balance available from the appropriation of August 2, 1882, for the Calcasieu Pass. The mouth of the river as heretofore considered is, as I understand it, the *débouchés* into the head of the lake, while the Calcasieu Pass is the strait connecting the lake and the Gulf. The same conditions exist in regard to the Sabine and Neches rivers, Sabine Lake, and Sabine Pass, and appropriations for use at the mouths of the rivers have referred to their *débouchés* into the head of Sabine Lake.

If the sum intended be that for the pass, the lake is considered a part of the river. Instructions on that point are desired if a project for the expenditure of funds available be approved.

The balance from the appropriation for the *pass* is $2,994.25, and if this be added to the balance for the river there will be available a total of $19,285.34, and if the *pass* be considered, under the act of July 5, 1884, as being the mouth of the river, then this sum can, it would seem by natural implication, be applied anywhere in the river, in the lake, or at the pass.

To make the conditions upon this river intelligible it is necessary to refer to previous reports and examinations.

An examination of the pass was made under Captain Howell's direction in 1871, and he reported in reference to it as follows (Report of Chief of Engineers, 1871, page 557):

> Its entrance from the Gulf is practicable at all stages of the tides for vessels drawing 5 feet or less. Its entrance from the lake is through the easternmost of two branches, and is closed at low tides to all vessels drawing more than 3½ feet by a mud and shell bar in length 1½ miles.

That is, the pass has an inner bar (at the lake end) and an outer bar (at the Gulf entrance). A cut through the inner bar, 60 feet wide and 6½ feet deep at mean low tide, was made in 1873–'74, and this cut having shoaled to 4 feet depth (Report of Chief of Engineers, 1883, page 212) a channel, 70 feet wide at the bottom, 8 feet in depth, and 7,500 feet in length was excavated across this bar in 1881–'82 (Report of Chief of Engineers, 1882, Part II, page 1386). The outer bar has never been worked on.

It appears from a report to Major Stickney of an examination made in the spring of 1883 (Report of Chief of Engineers, 1883, Part II, page 1127) that the bar at the head of the lake has a minimum depth of 5½ feet, and that in the river from this bar to the town of Lake Charles there is a minimum depth of 8 feet, and that it is comparatively free from snags, so that from the town of Lake Charles outward the points of least depth are, first, the bar at the head of the lake with 5½ feet of water, the inner bar of the pass dredged to 8 feet two and a half years ago, the present depth being unknown, and the outer bar of the pass, which had a depth of 5 feet in 1881.

The assistant who made the examination in 1883 under Major Stickney's direction reports as follows (Report of Chief of Engineers, 1883, Part II, page 1128):

> From captains of vessels in the lumber trade and from saw-mill owners and merchants at Lake Charles I have obtained the following information as to the commerce of Calcasieu River:
>
> First. "That the upper portion of the Calcasieu Basin lying above Lake Charles is a vast unsettled pine forest, with no commerce and never navigated except occasionally by a tug-boat sent up to tow down these booms of pine logs, and that the upper part of Calcasieu River is sufficiently deep and offers no obstruction to the navigation for which it is used."

Judging from all the above the bars at and near the extremities of the lake would at the outset alone seem worthy of attention, but the appropriation of March 3, 1881, was for the purpose of improvement from Phillip's Bluff (56 miles above the Lake Charles) to the mouth of the river. The present head of navigation seems to be 28 miles below Phillip's Bluff.

In reference to the portion of the river above the town of Lake Charles there seems to be somewhat conflicting reports.

First. From the reports of captains of vessels and as noted above, "it is sufficiently deep and offers no obstructions to the navigation for

which it is used, and Captain Howell, in 1871, states that it was reported navigable, at a good stage, to a point about 60 miles above Lake Charles" (probably Phillip's Bluff). Second. Assistant Engineer Bell, who made an examination in the autumn of 1880 under Captain Howell's direction, reports in the 28 miles below Phillip's Bluff, 452 snags, 1,045 leaning trees, and a bad bar near the lower end of this portion with scant 6 inches upon it at low water, which bar has been formed by an accumulation of snags. He reports in the succeeding 28 miles, down to Lake Charles, 121 snags and 135 leaning trees.

The apparent discrepancies may probably be reconciled by assuming that boats do not usually go above a point 28 miles below Phillip's Bluff, that they go above this only at high water, and that logs are rafted or otherwise floated out when the water is high.

To obtain further information I ordered Lieutenant Crosby, Corps of Engineers, to proceed to Lake Charles to obtain replies as to certain points given in a letter of instructions. His report, which is very satisfactory, is as follows:

NEW ORLEANS, LA., *December* 3, 1884.

SIR: Following instructions contained in your letter dated November 29, 1884, I have the honor to report the following facts: Arriving at Lake Charles, La., on the afternoon of December 1, I spent the remainder of the day and the whole of the following, in obtaining information bearing on the subject mentioned in your instructions. You first direct me to "make inquiry of all persons in the lumber trade as to the needs of navigation up the river, respectively, as to the present head of navigation (about 28 miles above Lake Charles) and as to the portion above this point to the head of navigation at Phillip's Bluff." There are ten saw-mills and four shingle-mills in or near Lake Charles, one saw-mill and one shingle-mill idle at present. I saw the owners or those who could speak for the owners of eight saw and three shingle mills. Among these I found a perfectly unanimous opinion as to the upper river. In substance they all agree that the stretch of river from Lake Charles to Jones Bluff offers excellent facilities at all seasons for all kinds of vessels; that for a distance of 8 or 10 miles above Jones Bluff the river may be navigated by light-draught vessels, the obstacle met being snags and sand-bars; while the rest of the course could scarcely be made navigable for freight-bearing vessels, though it answers very well as a logging stream. Several gentlemen were emphatic in their opinion that money would be thrown away if expended above Lake Charles, the first section needing no improvement, the second not being worthy of it. Among those thus speaking were Mr. Drew, representing three of the largest mills, and Mr. Keating representing the Calcasieu Lumber Company, who are largely interested both in sawing logs and also in getting them out. Mr. Keating has had experience in the northern (Michigan) lumber regions, and states that the Calcasieu is the easiest river for logging that he has worked on; all the mill men stated that they were satisfied with the logging facilities, and that there were no other interests to be subserved by any improvement of the upper river. Mr. Drew estimated that there were scarcely 500 men engaged in logging on the main river, while a very small part of these is to be found below Phillip's Bluff. Substantially the answers to all my inquiries concerning the needs of both sections of the river were, "we need nothing." Information to the same effect was obtained from several river men interviewed. Remembering that Mr. Keating speaks directly from the logman's point of view, as well as the miller's, it will be seen that all the interests concerned coincide.

As to the stages or seasons at which boats go to the different points above Lake Charles, Captain Wait, from whom I obtained much information, owns and runs two tugs, which are the only boats now running with any sort of regularity to any point above Lake Charles. He has a contract to tow all the logs put into the river by the company which Mr. Keating represents. He can go at all seasons and stages to Jones Bluff with ease, and with some difficulty to a tramway put in about 8 miles above. He averages about two trips per month.

Schooners occasionally go a few miles above Lake Charles to some of the adjacent mills.

As to the seasons and stages at which rafting is done, and whether an extension of the time is needful or desirable: The logs are brought done on the rises, of which two are expected every year, about June and one in the fall. The rafting season will average about two months per year, during which time all the logs that have been cut may be floated. The mills never have to stop for want of logs. An extension of the time of logging seems not to be desired.

As to "obstructions now met with:" None are found up to Jones Bluff, the practical head of navigation. Above that point snags and very shoaled sand-bars and overhanging trees abound.

The yearly cut of lumber around Lake Charles is worth about $75,000. About half of the logs sawed are floated from the West Fork of the Calcasieu, and about half of the lumber is shipped by rail. The lumber interest is the only one developed in the Calcasieu Valley. While the interested parties are unanimously satisfied with the upper river, they are unanimously urgent as to the great necessity of deeper water through the old cut at the head of the Calcasieu Pass. This has shoaled to 3½ feet at ordinary tide, and presents a great obstacle to the development of every interest in the valley; all the lumber must be lightened down to and over that point at a cost of about $1.50 per thousand feet, thus hampering the endeavor to compete in Mexican and other foreign ports with Mississippi and Florida supplies.

Very respectfully, your obedient servant,

O. T. CROSBY,
First Lieut. of Engineers.

Capt. THOMAS TURTLE,
Corps of Engineers, U. S. A.

I have to report that, in my opinion, no valuable purpose will be served by applying any of this money above the town of Lake Charles. As seen by Lieutenant Crosby's report, navigation is most hindered by the shoal at the lake end of the pass, which, it is reported, has again shoaled to its original depth. But no work can be done here unless the appropriation for the *river* can be applied to the *pass* through interpretation to that effect, as pointed out above. I am further informed by Lieutenant Crosby that the bar at the head of Calcasieu Lake is considered an obstacle, but of less moment than the other at the inner end of the pass.

I think it would be scarcely worth while to work upon the bar at the head of the lake, the bar at the foot of the lake being, as now reported, shoaled to its original depth. But unless the total sum available for the *river* and the *pass* can, by implication, be applied at the pass the funds available will not permit the commencement of any work there. Instructions are therefore necessary, and are respectfully requested.

It is questioned whether the former cut at the pass was made at the proper point. It was made on the shortest line, but those trading there report it as not the most favorable for approach by sail, and is where most exposed to filling up by the action of winds and waves. This is a point to be determined only after it be determined whether any work be done there at all.

A cut 100 feet in width upon the old line would require the removal of about 75,000 cubic yards, measured in place, if it be reduced to its original condition. A cut upon a line about in the extension of the pass would require the removal of about 95,000 cubic yards. It may be that the funds available for both river and pass will not permit the commencement of any work, but this can only be demonstrated by trial after decision upon the point presented.

I would respectfully recommend that an examination be made of this shoal at the river end of the pass if it be decided that the balance for both river and pass can be there applied.

Very respectfully, your obedient servant,

THOMAS TURTLE,
Captain of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

S 12.

IMPROVEMENT OF CALCASIEU PASS, LOUISIANA.

The work was in charge of Maj. Amos Stickney, Corps of Engineers, until July 23, 1884, and in charge of Capt. Thomas Turtle, Corps of Engineers, from that date until February 12, 1885, and in charge of Maj. W. H. Heuer, Corps of Engineers, since that time.

In 1874 a channel was dredged through the bar or flats at head of Calcasieu Pass. This cut refilled, and in 1881–'82 was a gain dredged through for a distance of 7,500 feet; a channel was made 8 feet in depth and 70 feet in width. This work was done by contract at a cost of $10,444.

The total appropriations for this work to date have aggregated $30,000, of which $27,074.75 have been expended on the improvement.

The latest information from this locality indicates that the dredged channel over the bar has again refilled to its normal condition before dredging, viz, 3½ feet of depth.

Both channels which were dredged over this bar were cut across the shortest line of the bar, were to a certain extent experimental, and urged by commercial and navigation interests so as to get immediate results. Since these cuts refilled so rapidly, a cause for this deterioration has been sought for, and it is believed to be partially due to the waves and currents passing between the lake and the pass, not acting in the line of the cut, and also due to the small number of steamers using the cut. As the directions of the seas and currents are to a great extent governed by the winds, and these are variable both as to direction and intensity, no channel can be excavated on the bar which shall at all times have the current and seas flowing in its axis, and therefore not subjected to some fill, but it is thought that if a cut be made across these flats, more nearly in the direction of the prolongation of the axis of the head of the pass than the old cut was, that the filling would be less rapid than formerly.

This channel would be longer than those formerly cut, would require more cubic yards of cutting, and therefore cost more than the others; whether or not it would be more lasting is not known; it is almost certain that it could not fill more rapidly than did the former cuts. The commercial interests on the Calcasieu require a navigable channel through this bar. It is really the only bad place which absolutely requires improvement on this stream, for with this bar obstruction no lumber-laden vessels can get out to sea nor supplies get into the river without being lightened at considerable expense.

This improvement is now in an unfortunate condition owing to the wording of the act making appropriation. Heretofore this bar has been dredged upon from the appropriation for "Improving Calcasieu Pass," which was clearly applicable to this work, but two later appropriations were made for improving "Calcasieu River" without specifying any particular locality for improvement, and it is not known that appropriations for improving the river can be properly applied to the improvement of the pass. It is certain that the improvement of the river proper is of no use so long as the present bar obstructs navigation at the pass. Should it be decided that money for the river can be applied to the bar at the pass, then work could go right ahead, as the money available for the river, together with that for the pass, would enable an effective channel to be cut at the pass, and any balance could then be used for whatever might be required in the way of improvement higher

up-stream. But to spend public money for improvement up this river with the bar at the pass unimproved would be a waste of public funds. As the funds certainly available for the pass are not sufficient to do any work there, no work has been done on either the pass or the river during the past fiscal year.

If it be decided that funds for the river can be used for the pass, or if further appropriations be made for the *pass*, then a careful examination will have to be made as to which line the proposed cut across the bar shall be made upon. It is thought the *cut* will cost about $16,500.

The commerce of the pass is entirely dependent upon that of the river, and the latter is estimated to have an annual value of $528,000.

Money statement.

July 1, 1884, amount available	$2,994 25
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	69 00
July 1, 1885, amount available	2,925 25

S 13.

IMPROVEMENT OF SABINE PASS AND BLUE BUCK BAR, TEXAS.

This work was in charge of Capt. Thomas Turtle, Corps of Engineers, until February 12, 1885, and in charge of Maj. W. H. Heuer, Corps of Engineers, since that date.

The object of the improvement is to obtain deep water over the bar at the entrance, so as to have access to the excellent harbor within and secure an outlet to the products of Texas and Western Louisiana.

In 1878 a channel 12 feet deep was dredged across the bar; another was dredged in 1880; both soon refilled. The result showed that dredged channels without protecting works or constant dredging at heavy expense could not be maintained. The amount of money spent in dredging and repairs to dredging machinery at this locality aggregated about $167,000. After careful examination, surveys, and further study of the harbor had been made, a project for getting deep water was submitted in 1882 to construct two jetties extending from shore to deep water in the Gulf, each jetty to be a little less than 4 miles in length, and estimated to cost when completed, together with the dredging between the jetties, $3,177,606.50. This project, report, and estimate was at my request referred to a Board of Engineers for consideration. Their report, printed in Annual Report of Chief of Engineers for 1882, Vol. II, page 1438, was submitted to Congress and printed as House Ex. Doc. No. 147, Forty-seventh Congress, first session. On August 2, 1882, Congress appropriated $150,000 for this work. This amount, together with an unexpended balance of former appropriations, made about $300,000 available with which to commence operations on one of the jetties. The work was let by contract; work was commenced in 1883, and in 177 working days in that year 118,552 cubic yards of jetty were laid, embracing a total length of 16,074 feet of foundation in the west jetty, 6,146 feet of which from the shore end was built nearly or quite up to the level of mean high water.

This nearly used up the total amount of money available, and work was stopped until the next appropriation, made July 5, 1884, of $200,000

became available. A survey and examination of the work was then made by and under the direction of Captain Turtle, the officer then in charge of the work, to ascertain the condition of the jetty, also to note any changes which might have occurred within the harbor or on the bar, and also to ascertain whether the jetty had produced any deflection or increased velocity of the currents in its immediate vicinity.

The results of this survey are appended, as well as a report on the subject by Captain Turtle, who therein suggests a new line differing somewhat from the originally-proposed line of the east jetty.

NEW ORLEANS, LA., *November* 10, 1884.

GENERAL: I forward you to-day tracings of two charts of the sea entrance of Sabine Pass, Texas, made from surveys in August, 1884.

The survey and charts were made by Mr. T. L. Raymond, assistant engineer, and his report, which clearly sets forth the developments of the surveys, inclusive of the condition of the partially constructed works, the changes wrought upon and near the bar since the former survey of 1881, and the result of the float observations, is as follows:

"SABINE PASS, TEXAS,
"*September* 20, 1884.

"SIR: I have the honor to submit the following report upon the survey of the mouth of Sabine Pass, Texas, noting specially the following points indicated in your letter of instructions dated July 25, 1884:

"*First.* The changes which have occurred since the date of the last survey.

"*Second.* The character of the bottom to determine the origin of deposits.

"*Third.* The condition of the mattress work and amount of its subsidence.

"*Fourth.* The direction of ebb currents upon the bar and of all currents upon the line of the jetty.

"*Fifth.* Quantity of oyster shells available for ballasting future work.

"CHANGES SINCE LAST SURVEY.

"A comparison of the chart of the survey just completed, which accompanies this report, with that of the survey of December, 1881, shows the following changes in depth to have occurred:

"In the narrow throat of the entrance opposite the light-house the maximum depth has increased from 24.9 feet in 1881 to 28.7 feet in 1884, a gain of 3.8 feet.

"This rate of increase in depth is maintained through the deepest water to a distance of 4,000 feet below the light-house, where the maximum depth has increased from 19.8 feet in 1881 to 23.7 in 1884. Below this point, where the widening of the water-way becomes more marked, the increase of depth is not so great, being 1.2 feet opposite the beginning of the jetty where the depth was 13.7 feet in 1881 and 14.9 feet in 1884.

"This amount of increase continues with slight variations, more particularly where the deep-water line approaches the jetty to within about 500 feet of the *Clifton* just seaward of the former crest of the bar. Here the difference in depth at the dates of the two surveys diminishes rapidly, showing the deepest water across the bar to be 6.4 feet at present while the greatest depth in 1881 was 6.1 feet.

"The line of deepest water over the bar has moved somewhat to the eastward by the formation of a shoal opposite the *Clifton* and extending from the jetty 1,000 feet east, upon which the depth has decreased from 0.6 to 1.3 feet since 1881.

"Beyond the *Clifton* to the borders of the sand deposit there has been no change in depth.

"Over the area covered by the sand deposit the depth has diminished from one-half foot to one foot, the shoaling being greatest near the jetty and midway across the area.

"Beyond this there has been a general deepening within the limits of the surveys, but the increase of depth is not uniform, varying between a few tenths of a foot and 1½ feet. Along the edges of the jetty and immediately beyond the end the deepening produced by cross-currents has been from 3 to 4 feet.

'On the west side of the jetty from shore to where the depth was formerly 10 feet there has been a very marked shoaling. From the shore to 1,000 feet beyond the *Clifton* the depth over the whole area is now nowhere greater than 3 feet, there having been formerly from 5 to 7½ feet of water here.

"From the edge of this shoal to where the depth was formerly 10 feet the decrease in depth has been about 1½ feet since 1881. Beyond this to a depth of 13 feet there

CHART
OF
ENTRANCE
TO
SABINE PASS
TEXAS

Showing progress of construction of the jetties to June 30th 1885

under direction of

Maj. W. H. HEUER, *Corps of Engineers, U.S.A.*

Thos L. Raymond Assist Engr.

Scale of Feet

0 500 1000 2000 3000 4000 5000 6000

Note

Soundings are reduced to mean low tide and were part of those taken in August 1884 except those in circles taken June 1885

Curves are shown thus; 6ft ..... 9ft. - - - - 18ft ———

LONGITUDINAL SECTION EAST JETTY

0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000 11000

M.H. Tide
M.L. Tide

Vertical Scale of Feet
0
10
20

LOUISIANA POINT

SABINE PASS LIGHT HOUSE

QUARANTINE

TEXAS POINT

Wreck of Clyde

LONGITUDINAL SECTION WEST JETTY.

0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000 11000 12000 13000 14000 15000 16000

M.H. Tide
M.L. Tide

Built in 1883

Vertical Scale of Feet
0
10
20

H Ex1 pt2 v2 491

has been no change, while from a distance of 1,500 feet inside the present end of the jetty there has been a deepening of 1 foot out to the limit of the survey.

"Upon the chart which accompanies this report these changes are shown more generally by the relative positions of the curves of the same depth, those drawn in red being taken from the chart of 1881.

"*Eighteen foot curves.*—It will be noted that the inner 18-foot channel has widened since 1881 about 150 feet, and the curve of this depth has advanced 600 feet beyond its former southern end. The outer 18-foot curve has receded irregularly from 200 feet to 1,100 feet; thus the distance between the depth of 18 feet inside and that outside the bar has been lessened 1,600 feet.

"*Nine-foot curve.*—The width of the inner 9 foot channel has increased throughout, the greatest increase being about 1,000 feet near station 20 on the jetty. This curve has also moved down toward the bar a distance of 2,150 feet.

"The position of the outer 9-foot curve has changed but little, so that 2,150 feet represent the diminution of the distance between the inner and outer 9-foot depth.

"*Six-foot curve.*—The position of the 6-foot curve shows but little change until a point is reached opposite the beginning of the jetty, where this channel begins to widen until its least width across the bar has increased from 550 feet in 1881 to 2,300 feet at the present time. A 6-foot channel is now shown to have been cut through the shoal off Louisiana Point, upon which there was formerly a depth of 4½ feet to 5 feet.

"With all these curves the movement has been upon the eastern side, their positions upon the western side of the pass remaining unchanged to a great extent, except in the case of that portion of the 6-foot curve near the *Clifton*.

"It is worthy of notice that as the amount of the change in depth decreases in approaching the bar the amount of change in width of channel increases, or, as opportunity is afforded for the water to spread, the water is widened rather than deepened.

"The crest of the bar, as determined by a line joining the points of the 6-foot curve nearest together, has advanced into the gulf 1,900 feet.

"The changes in depth are further illustrated by the profile of the line of the proposed east jetty shown upon the chart.

"To the westward of the west jetty the 9-foot curve has advanced between 700 and 1,100 feet, and the 6-foot curve inside the *Clifton* has been obliterated by the deposits, while outside the *Clifton* it has advanced 2,700 feet.

"CHARACTER OF THE BOTTOM.

"The general character of the bottom elsewhere than on the sand area is a very soft mud, the exceptions being a few hard-mud areas of limited extent, and a very few isolated spots where shell was found. The extent and position of the sand deposit would seem to leave but little doubt as to its origin.

"As shown upon the chart by the dotted area, it lies almost entirely upon the east side of the west jetty, the small deposit to the westward having been probably carried over the top of the jetty. The main deposit extends to the eastward to a point nearly on the prolongation of the 6-foot curve on the east side. Its width is greatest near the jetty, and diminishes as it extends to the eastward until it finally disappears. Its northern limit is found in a depth of 6.5 feet almost uniformly, while its southern edge is nearly coincident with the 9-foot curve.

"These facts seem to show that this sand was brought out of the pass by the exceptionally strong currents of the remarkably high-water period of last spring and deposited immediately in front of the entrance to the pass upon the beginning of the outer slope of the bar just where the current receives its first serious check in passing over the crest of the bar, and at no greater distance seaward than the 9-foot depth is found. Repeated trials failed to drive a pole through the deposit except along the edges.

"CONDITION OF THE MATTRESS WORK AND AMOUNT OF ITS SUBSIDENCE.

"Repeated and careful inspection of the mattress work which appears above water during low tides failed to reveal any serious loss of material, the only gap in the top tier of mattresses being at station 21, where about one-half of one mattress has been carried away, as will be seen by the comparative profile of the jetty shown upon the chart; four mattresses at this point were originally but little above the mean low-tide line with higher work on either side.

"The currents were, therefore, concentrated through this opening, and to this cause is probably due the loss noticed, as the deposit behind the jetty effectively protected this part of the work from any serious wave action.

"From the shore to this point there has been no loss and no subsidence since last reported upon.

"Seaward of this break the second tier of mattresses has lost many of the fascines owing to the rotting of the ropes; particularly does this seem to be the case when the fascines were made of cane, which break up more readily than those made of brush, as the rope bindings give way.

"The profile shows this portion of the work to have an elevation from one-half foot to 2 feet lower than when built and the loss of fascines; the compression of the brush and settlement into the bottom will account for the maximum subsidence leaving no margin for loss of brush from the body of the mattresses.

"A careful sounding on two occasions over the whole of the submerged portion of the jetty does not reveal any break in its continuity, and from the end of the second tier to a point 3,500 feet beyond the *Clifton* the profile does not show a greater subsidence than that found to have occurred on the second tier. Beyond this the depth of water prevented the soundings from being taken with certainty upon the highest part of the sloping mattresses, and the profile shows an apparent subsidence, which may be actual, of from 2½ to 3½ feet at various places. In no case, however, was any break discovered.

"An examination of some of the brush, both inside and outside the *Clifton*, shows that the teredo has entered much of that not protected by mud deposit, but the growth of oysters and other shell fish upon the brush so exposed has probably fully counterbalanced the loss of material sustained from this cause. It is a question, however, whether the removal of a part of the heart of the brush impairs its usefulness as a jetty material, its effective bulk being undiminished by the loss.

"DIRECTION OF EBB CURRENTS UPON THE BAR AND OF ALL CURRENTS UPON THE LINE OF THE JETTY.

"Upon a separate sheet, forwarded herewith, are shown the results of observations of the currents at the mouth of Sabine Pass, made under the varying conditions of wind and tide noted for each float upon seven days. In the cases of ebb currents upon the bar, the rates are also given on the tracing. The method employed for ebb currents upon the bar was the location of the position of the float every two minutes. The points of the arrow heads indicate such position, and the depth at which the fan was set is noted at the beginning of every line. The currents upon the line of the jetty were observed solely with reference to their direction by determining the bearings of the directions taken by the floats set out from fixed points.

"As will be noticed, the direction of the ebb current inside the line joining Louisiana Point with the end of the second tier of mattresses is generally parallel to the axes of the channel, and but slightly affected by the wind. Beyond this line the prevailing wind, though light, has a decided influence.

"The rate of the current is observed to diminish as the pass widens, and is, of course, dependent upon the stage of the tide.

"On the line of the jetty the effect of the wind is even more marked, as the currents have a tendency to make a course normal to the direction of the jetty at the point of observation.

"QUANTITIES OF OYSTER SHELLS AVAILABLE FOR BALLASTING FUTURE WORK.

"Immediately above the light-house, and in the center of the pass, is a shoal dividing the Texas and Louisiana channels. This shoal is mainly an oyster reef. Its extent is about 180 acres, and the depth of the shell layer is known to be more than 3 feet at several places upon it where tests have been made. This reef alone would therefore probably furnish 900,000 cubic yards of shells, if this estimate of its depth is correct, for the entire area of the reef. Besides this there are several smaller reefs which would yield a very considerable supply of shell ballast. One of these latter lies across the channel, near the life-saving station, with only 13 feet depth upon it. In this connection it may be stated that the condition of the trial mattress, which was ballasted entirely with shells, compares favorably with that of the mattress near it, it being noticeable, however, that most of the shell ballast has been washed over to the west slope of the mattress and affords no protection to the top brush against wave action.

"EFFECTS DUE TO THE JETTY.

"The strong currents due to the extreme high water of last spring having deepened the channel above the jetty where the work cannot be claimed to have had any effect, it is perhaps impossible to decide as to the amount of influence the work done has had upon the depth of water across the bar.

"The greatly increased width of the 9-foot channel and its prolongation so far down-stream might fairly be attributed to some extent to the narrower water-way produced by the jetty. It is possible, too, that had it not been built the current would not have been strong enough to carry the sand so far as it did, but would have

dropped it in shoaler water and thus reduced the available depth across the bar. The general deepening, however, does prove that when the water-way is confined, as would be the case were a second jetty built, the power does exist in the current here to scour the bottom, which has been denied at times with reference to this bar.

"Very respectfully, your obedient servant,

"THOS. L. RAYMOND,
"*Assistant Engineer.*

"Capt. THOMAS TURTLE,
"*Corps of Engineers, U. S. A.*"

This survey gives us a gratifying evidence of beneficial results thus far, and with the facts here determined and those of previous reports and examinations it is required to prepare a project for the expenditure of the recent appropriation of $200,000, for continuing the work of improvement.

Authority has already been granted to advertise for the quantities of stone required for the probable amount of work which can be performed with the funds available.

It is to be determined whether work should continue upon the jetty already commenced or commence upon the east jetty. The float observations show no general set of the current against the line of the west jetty at the distance from shore to which the observations extend and which would indicate the desirableness of continuing this jetty in length and height.

The movement of the curves of 6 feet depth with the widening of the channel as limited by these curves and its changes to the eastward, in my opinion, indicates the necessity of opposing the change and counteracting it by a jetty on the eastern side of the channel to be established.

I have therefore to recommend that the funds now available be expended upon the construction of the east jetty. This coincides with Captain Heuer's opinion expressed in his last report, dated January 14, 1884, and included in the Annual Report for this year.

The location of the shore end of the jetty and its position setting out therefrom with reference to the west jetty already commenced must be established now.

My predecessor, Capt. (now Major) W. H. Heuer, upon the charts made under his direction, laid down a line (A B on the charts now submitted) for the proposed east jetty.

In his report printed in the Report of the Chief of Engineers for 1882 (see pages 1433-35, Part II), he presented his views for a distance between jetties not greater than 1,800 feet and afterward, I believe, concluded to reduce the distance to 1,500 feet, as shown on his charts and as here laid down. The Board of Engineers (see page 1439) considered it not necessary at the time (March 11, 1882,) to decide in reference to this jetty. That distance between jetties should undoubtedly be chosen, which will maintain the greatest depth of channel to the sea, and I neither intend to affirm nor deny that the distance indicated by Major Heuer may not do so.

I desire to call attention to the fact that if the jetty be commenced on the line A B, the project, so far as it relates to the distance between jetties, will at the outset be established beyond recall, unless at much expense or by a further decrease of width, which is, I think, scarcely probable. Little would be left for future study or the application of experience as the work progressed. This is not a project for the rapid completion of the entire work; on the contrary, we have to expect fragmentary appropriations at irregular intervals.

I feel it desirable that the project should have more flexibility than the adoption of the line A B would permit. It is better that the distance at the outset should be too great than too little, and the determination of the distance can at the best be but an approximation.

Examination shows that the material of this bar is a soft mud. A structure placed upon it is then very liable to be undermined by scour. Experience can only determine the extent of this liability. It may be that it will be found needful to protect the jetties from too great scour by spurs perpendicular to them, which would practically decrease the width of the channel.

I have, therefore, to present for consideration and adoption the line C D E. The line begins at nearly the same point upon the Louisiana shore as the former proposed line, gains by a branch a position nearer to the west jetty, and thence, as shown, to the point E, at about which point it is estimated that work under the present appropriation would terminate.

I would fear with the former proposed line that the current would infringe too strongly upon that portion in the vicinity of the point D of the line now proposed, and immediately seaward of that point, subjecting the structure to great scour, especially during construction, and that afterward the change of direction of the current would be so abrupt as to create an injurious "cross over" below. The location now proposed it is hoped will advantageously modify these conditions.

At the point E the line of the east jetty would be about 2,150 feet distant from the line of the west jetty.

These matters are now presented for the consideration and decision of the Chief of Engineers. When the determination is made I shall have the honor to submit specifications for the performance of the work by contract in due time.

Very respectfully, your obedient servant,

THOMAS TURTLE,
Captain of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

This report was referred to a Board of Engineers in New York City, consisting of Generals Duane, Abbot, and Comstock, of the Engineer Corps, U. S. Army, who approved substantially of the line of the proposed east jetty as recommended by Captain Turtle, but suggested a slight change of direction at its shore end. The following is their report:

REPORT OF BOARD OF ENGINEERS.

OFFICE OF BOARD OF ENGINEERS FOR FORTIFICATIONS
AND FOR RIVER AND HARBOR IMPROVEMENTS, &C.,
New York, December 1, 1884.

GENERAL: The Board of Engineers to whom was submitted, by letter of the Chief of Engineers, of November 24, 1884, a project of Captain Turtle, of November 10, 1884, for the expenditure of an appropriation of $200,000 for the improvement of Sabine Pass, Texas, makes the following recommendations:

1st. That enough of the appropriation be used to protect the west jetty as it now is and to prevent injurious scour at its end.

2d. That the balance of the appropriation be used in building the eastern jetty continuously from its shore end. This jetty should not be carried above low water until experience shows it to be necessary. It should nowhere approach the western jetty nearer than 2,000 feet, the existing width of the pass near the Sabine Point light-house, where the forces now in action maintain a depth of from 20 feet to 25 feet, being about 2,100 feet.

The line marked C D E, for the position of the west jetty, on Captain Turtle's plan, seems in general to be a judicious one. But the angle 800 feet from the C shore end should be avoided by prolonging the main arm D E of the jetty to its intersection with the shore line.

Even then the distance between the jetties at their upper end is probably too great to give 20 feet depth by scour, and the forces in action may need to be supplemented there by dredging or by contraction works on the western side.

The papers transmitted in connection with this subject are returned herewith.

Respectfully submitted.

J. C. DUANE,
Col. of Engineers, Bvt. Brig. Gen.
HENRY L. ABBOT,
Lieut. Col. of Engineers, Bvt. Brig. Gen.
C. B. COMSTOCK,
Lieut. Col. of Engineers and Bvt. Brig. Gen.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

On October 15, 1884, after due advertisement, proposals were opened for furnishing 6,000 tons of rock at Sabine Pass, with the privilege on the part of the United States to increase the amount to 12,000 tons if deemed necessary.

The following is an abstract of the bids received:

No.	Names of bidders and their residences.	Amount bid per ton.
1	A. M. Shannon & Co., Galveston, Tex	$3 72½
2	The Louisiana Jetty and Lightering Company, New Orleans, La	3 70
3	G. A. Myers, New Orleans, La.*	11 20

* Bid received at 1.15 p. m.

Awarded to Louisiana Jetty and Lightering Company, at $3.70.

On January 28, 1885, after due advertisement, bids were opened for furnishing brush-mattresses in place per cubic yard, also for placing the rock in place in the jetty, and the following is an abstract of the bids received:

No.	Names of bidders and their residences.	Brush-mattress in place per cubic yard.	Placing rock ballast per ton of 2,240 pounds.
1	Rittenhouse Moore, Mobile, Ala	$2 00	$0 90
2	R. Walston, Galveston, Tex	1 86	85
3	A. M. Shannon & Co., Galveston, Tex	1 90	1 00
4	David W. Howell, Brunswick, Ga	2 31	1 27
5	H. H. Penny, 63 Broadway, New York City	1 87	69
6	James E. Slaughter, Mobile, Ala	2 09 $\frac{22}{100}$	99 $\frac{80}{100}$
7	Louisiana Jetty and Lightering Company, New Orleans, La	1 80	60

Contract awarded to Louisiana Jetty and Lightering Company, at $1.80 and 60 cents.

Work was commenced on the east jetty in March, 1885, and on June 30, 1885, the foundation course was laid for a distance of 10,200 feet from shore, and 8,825 feet of this jetty extending out from the shore was built up to mean high-water level so as to permit the construction of the jetty, note the subsidence and permit of the accumulation of mud behind it, and thus add to its stability.

The contractors will probably finish their work in August of this year. An examination of the work made in May, 1885, shows that the teredo has not materially injured the work in the west jetty, which has been in place for upwards of two years; that some subsidence and compression is occurring in both jetties; that mud is rapidly accumulating on the outside of both jetties, thus adding to their stability, and that the current between the jetties has been gradually increased by concentration and its direction modified, and there is every reason to believe that if the work be continued as designed that the results will be fully as successful as were hoped for when the project was made and approved. The brush work of the jetties is being quite well covered by a growth of young oysters.

The portions of jetties thus far built have produced no material changes in the depth of water on the bar, nor at this stage of the work were any decidedly favorable changes to be expected; the tendency of the jetties if left in their present condition might, and probably would, be to push the crest of the bar seaward, for whatever scour would result would be due to a concentration and increased velocity of the current, and this could only occur inside of and slightly beyond where the jetties were built up sufficiently high to produce this effect. On the bar itself the jetties are not yet built high, owing to the small appropriations; as soon as the current disperses beyond the high part of the jetties the currents will be reduced and the sediment will drop or cease to be pushed much further seaward.

The foundation course must be kept at least 1,000 feet or more in advance of the high part of the jetty, otherwise the current would produce a scour at the sea ends of the foundation mats and cause deeper water there; more cubic yards of mattress would have to be built, and this means increased expense to the United States; besides we already know from experience that when the foundation tier is less than 1,000 feet in advance of the high part of the jetty the current is so increased

at the end of the foundation course that it is a very difficult matter to hold a mattress in place to sink it.

When the two jetties are built up high to the outer crest of the bar, then a scour may reasonably be looked for; should the expected scour not occur, then resort would be had to the dredge, which has been estimated for in the project, and with every indication that the depth so obtained would be practically maintained.

When the present contract is completed, about $500,000 will have been expended on the jetty project, and just about one-fifth of the original project of jetty construction will have been completed.

Jetties, to produce the best results, require continuous rapidity of construction until completed. This cannot be accomplished with small appropriations, such as have been made; for in less than six months, with a limited plant, and working on only one jetty, the appropriation becomes exhausted, the plant becomes idle, is costly to preserve and keep in repair; at the end of each contract enough money must be retained to protect the uncompleted jetty—keep it in repair—which must be necessarily large owing to the uncertainty of knowing when another appropriation will become available. With sufficiently large appropriations work would be continuous; both jetties could progress simultaneously, and in consequence of greater quantities of material consumed in jetty construction, the contract price for same to the United States ought to be considerably less than under the present system.

If it be the policy of the Government to continue this work to completion, then in an engineering point of view the most economic results can be obtained by an appropriation of $1,000,000 for expenditure during the fiscal year ending June 30, 1887. With smaller appropriations good work can be done, but it is believed that no decided increase of depth of water nor increased commerce will result until the jetties are built up to high-water level near the outer crest of the bar, and to do this will require, in round numbers, $1,000,000.

The amount of commerce passing Sabine Pass is not exactly or even approximately known. One or two very small schooners per week pass in or out carrying lumber or stores.

Any increase in commerce at this place is purely prospective and will be entirely dependent upon the results of the improvement contemplated.

The entire work has been in local charge of Assistant Engineer Thomas L. Raymond, who has rendered most excellent service.

Money statement.

July 1, 1884, amount available		$1,966 29
Amount appropriated by act aproved July 5, 1884		200,000 00
		201,966 20
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$94,063 83	
July 1, 1885, outstanding liabilities	49,032 65	
		143,096 48
July 1, 1885, amount available		58,869 81
Amount (estimated) required for completion of existing project		2,500,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		1,000,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

REPORT OF MR. THOMAS L. RAYMOND, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Sabine Pass, Texas, July —, 1885.

SIR: I have the honor to submit the following report upon the work of improving Sabine Pass, Tex., during the year ending June 30, 1885:

Under the present plan of jettying the entrance to this harbor the foundation course of the west jetty was begun January 1, 1883, and carried out during that year to the 16-foot curve, a distance of 16,074 feet from its starting point at the shore, and 6,146 feet of this was raised nearly to the plane of mean high tide by adding a second course 4,746 feet long. This work exhausted the appropriation and nothing more was done here until August, 1884, when a survey was ordered to determine the changes in depths and currents which might have taken place, as well as the condition of the work which had been done the previous year. Upon the completion of this survey a full report of the results was made to Capt. Thomas Turtle, Corps of Engineers, then in charge of the improvements.

The charts forwarded herewith are reduced from that of the soundings then obtained, to which have been added the plan and profiles of the mattress work constructed since, and a few soundings taken recently between the lines of the two jetties indicating the changes going on under the influence of the concentrated current.

The line of the east jetty decided upon, as shown upon the chart, begins at the shore, 2,700 feet below the light-house, and opposite a channel depth of 21 feet, extends in a straight line a distance of 6,545 feet nearly parallel to the 6-foot curve on the opposite shore of the pass, and follows a depth which was at the time of the survey nowhere greater than 7 feet. At the end of this straight reach the jetties are 2,640 feet apart, with a maximum depth of 11 feet between them. From this point a slight deflection is made towards the west jetty and the new direction followed for a distance of 1,177 feet. Second, third, and fourth deflections are made toward the west jetty at points about 1,200 feet apart, gradually cutting across the observed direction of the ebb currents thrown to the eastward by the west jetty and narrowing the passage-way at the former crest of the bar to 2,300 feet. The projected line beyond where the work ended on June 30 is straight, but its direction is slightly inclined towards the west jetty, reducing the opening between the jetties when a depth of 20 feet is reached to 1,800 feet.

CONSTRUCTION.

East jetty.—The methods used in construction by the present contractors, the Louisiana Jetty and Lightering Company, being the same as those adopted by the former contractors, the plant also being identical, it is unnecessary to repeat the descriptions given under these heads in the Report of 1883. As it had been determined to build the east jetty above mean high tide to as great a distance as possible under the present contract, while raising the west jetty to an equal height to an equal distance from shore, construction was begun on the east side at the shore on March 6, and was continued upon this jetty until the latter part of June, when a small amount of work was done on the west jetty. The construction of the mattresses has been altered somewhat from that formerly required at this place. The grillages of fascines confining the brush are now bound together by rat-line at every alternate crossing and by galvanized wire at each of the remaining crossings, instead of by rat-line alone at every alternate crossing throughout the body of the mattress and at every crossing around the edges. The fascines are now made entirely of brush, cane having been formerly used to a great extent, and extra fascines and double fastenings are now used at the end of the mattresses to strengthen them where exposed to sea action. Experience has proven these changes to be advantageous. The contract for the delivery of stone having been let previous to the advertisement of the construction contract, no delay has been caused by the lack of ballast, as was the case in 1883. On March 6 the construction of the east jetty was begun by building mattresses in place 15 feet wide and above mean high tide in the shoal water 800 feet from shore. This work was continued until shore was reached, and then extended seaward until 3 feet depth at mean low tide was reached 1,300 feet from shore. Foundation mattresses were then floated into place, their width being 30 feet to permit of their receiving a second tier, and this width was retained until a depth of 6.6 feet was reached, making a length of 2,423 feet of foundation of 30 feet wide. The remainder of the 10,200 feet, or 6,487 feet of foundation, is uniformly 40 feet wide, sunk in depths not greater than 7.5 feet. During the progress of this work the construction of the second or top tier of mattresses upon the foundation-course was carried on, the latter being kept well in advance to avoid unnecessary scour around the end and injury from storms. The attempt was made to float these top mattresses into place, but the uncertainty of the tides and difficulty in obtaining sufficient height by this method induced its abandonment, and the greater part of the superstructure was built in place. The whole o

the top course, built on a foundation of mattresses, is 7,400 feet long and has a width of 15 feet, and raised the jetty above mean high tide continuously for a distance of 8,700 feet from shore. A short reach, however, has settled since being built, so as to bring portions of the work somewhat below this plane. The amount of ballast used upon this jetty has varied greatly with the character of the work and the degree of exposure to injurious forces.

On the inshore work, where but little wave or current action may be expected, only sufficient stone was used to hold the brush should the bindings give away. Upon the foundation, only exposed a short time without the protection of the second tier, only such a weight was placed as was deemed sufficient to hold it in position. The top tier was completely covered with stone, leaving only the ends of the fascines exposed. These it was not possible to cover without building up with riprap from the foundation on both sides, which would have involved an expenditure of much more stone than the money available would have warranted.

On June 30 there had been placed in the east jetty 177 mattresses containing 56,401.6 cubic yards of brush, weighted with 6,632 tons of stone. The foundation was laid to a distance of 10,200 feet from shore, and the jetty completed 8,700 feet from shore.

West jetty.—The condition of this jetty as far as could be ascertained by sounding was reported upon at the time of the survey of August, 1884, and its height at that date is shown in the longitudinal section upon the chart transmitted herewith. An examination at very low tide, as far out as the wreck of the Clifton, recently made, shows but little change since that time. The subsistence of about 2 feet then noted made it necessary to raise this jetty, and in the latter part of June this work was begun by building mattresses 10 feet wide from station 18 + 80 towards shore. Before the close of the month 16 of these mattresses had been built, and one 15 feet wide at the outer end, but owing to delay in obtaining stone they were left without ballast several days, and on June 30 only 10 of them had been loaded and accepted. The shoal water on either side of this light work assures its safety. The amount of work done upon west jetty under the present contract to June 30 is 10 mattresses, containing 874.4 cubic yards weighted with 221 tons of stone, and the length of the work is 1,000 feet.

LOSSES.

On April 19 when the end of the foundation-course was at Station 44 + 23, east jetty, a heavy gale set in and continued for five days with scarcely a lull, raising the tide 2 feet above mean high tide, and overflowing part of the town of Sabine Pass. During the early part of this storm the mattress at the end of the foundation-course was carried by the flood current around the end of the work away from its position and up the pass about 3,000 feet. The mattress had been loaded with 28 tons of stone, about twice the amount used to sink it originally. In attempting to raise it afterwards considerable ballast was found upon it, and the effort to save it failed. The next mattress thus left at the end of the work was injured to the extent of about 150 cubic yards lost, but its position was not altered. Since that time, though several storms have occurred, no injury has been sustained by the work.

RESULTS.

During the progress of the work soundings have been taken upon a few lines between the jetties and out as far as the bar. Most of the soundings upon the accompanying chart are taken from the survey of August, 1884, but a few, indicated by a surrounding circle, are added from soundings taken June 23, 1885, to show the character of the changes taking place at this early date. From a comparison of depths upon a larger scale, a deepening is observed since the work of this year was begun over the whole area sounded lately, diminishing, however, to only a noticeable amount at a distance of 2,000 feet beyond the end of the east jetty foundation at the time the soundings were taken. Considering the 8-foot contour, it has advanced toward the bar since the work on east jetty was begun about 800 feet, and increased in width of channel where this depth formerly existed 400 feet. The 7-foot contour has advanced in the same time 1,100 feet, and the width of the 7-foot channel is only limited by the jetties.

The pressure of other duties has not permitted an elaborate survey as yet, but decided results cannot be expected on the shoalest part of the bar until the completion of the present contract, when both jetties shall have been raised above high tide to within 1,500 feet of the crest.

I am indebted to Mr. D. R. January for the careful and conscientious discharge of his duties as inspector.

Very respectfully, your obedient servant,

THOS. L. RAYMOND,
Assistant Engineer.

Maj. W. H. HEUER,
Corps of Engineers, U. S. A.

S 14.

IMPROVEMENT OF SABINE RIVER, LOUISIANA AND TEXAS.

This work was in charge of Capt. Thomas Turtle, Corps of Engineers, until February 12, 1885, and in charge of Maj. W. H. Heuer, Corps of Engineers, since that date.

A survey of the mouth of this river was made in 1871; it had a channel over the bar 3½ feet deep. In 1872–'73 the survey was extended from the mouth to Belgora, Tex.; the information obtained did not warrant the expenditure of any money for improvement above Hamilton, Tex., about 247 miles above the mouth, to which point there is 3 feet depth for about three months in each year. The estimated cost of improvement over this stretch of river by removal of obstructions, such as logs, snags, fallen trees, &c., was $18,000. In June, 1878, Congress appropriated $10,000 for the improvement, with which a channel 6 feet deep, 70 to 100 feet wide, was dredged over the bar at the mouth. March 3, 1879, Congress appropriated $6,000 more and provided for a resurvey of the river from its mouth to East Hamilton. After this survey was completed it was deemed advisable to expend this money in improving the river above Orange, and cuts were made from the main river into the narrows and at Dead Bend; large numbers of sunken logs and snags were removed from the upper part of the narrows, enabling vessels of 5 feet draught to get 30 miles up river above Orange.

In 1880 Congress appropriated $5,000, and in 1881 $7,000 more for this river. The bar at the mouth had again shoaled; this was redredged in 1881–'82 to a depth of 6 feet, and a channel 100 feet wide was made a little over a mile in length.

In 1882 Congress appropriated $4,000 more for this improvement. As the river is in a sufficiently good navigable condition for the limited commerce which it carries, this money has not been used, and it, together with a small balance left over from former appropriations, is yet available. No work has been done during the past year.

CONDITION OF THE WORK AT PRESENT.

The dredged channel has shoaled somewhat and many saw-logs have been lodged in it, but there is a deep enough channel for the very limited commerce using the river, and while the commerce is so small, and not perceptibly increasing, it is deemed inadvisable to make any further improvement at present.

It is not evident that the improvements thus far made have been of much, if any, commercial advantage when the channel was at its best; freight rates were not reduced, nor did the commerce on the river perceptibly increase. No appropriation for the fiscal year ending June 30, 1887, is asked.

Money statement.

July 1, 1884, amount available	$4,546 56
July 1, 1885, amount available	4,546 56

S 15.

IMPROVEMENT OF NECHES RIVER, TEXAS.

This work was in charge of Capt. Thomas Turtle, Corps of Engineers, until February 12, 1885, and in charge of Maj. W. H. Heuer, Corps of Engineers, since that date.

The Neches River was surveyed in 1872–'73 from its mouth to Boonsville, 195½ miles, and was found to be navigable at all stages to Weiss Bluff, 51 miles from its mouth, and above that point only during high water; a large amount of lumber being shipped annually to Sabine Pass and Galveston. The principal obstruction to navigation was the bar at the river's mouth, the depth of water on which was 3 feet at low tide; the bar is of fine sand and mud, the deposit of the river.

An estimate for dredging a channel to 5 feet depth, involving the removal of 47,851 cubic yards of material, was submitted, amounting to $26,318.

The act of June 18, 1878, appropriated the sum of $8,000 for deepening the channel at the mouth of the river and removing obstructions to Beaumont. Advertisements under this act for dredging on the bar failed of result, and after the passage of the act of March 3, 1879, appropriating an additional $5,000 to the work, readvertisements were made, and under the resulting contracts a channel was excavated to the depth of 5 feet and more at mean low tide, and to an average width of 60 feet, except for 1,200 linear feet at the crest of the bar, where the width was about 30 feet. An additional appropriation of $5,000 was made by the act of June 14, 1880. It was contemplated to use the funds thus made available in removing snags and overhanging trees, between Bevilport and Yellow Bluff, but as the estimate for this work resulting from the resurvey of 1880 amounted to $15,000, operations were suspended until after the act of March 3, 1881, appropriated the sum of $3,000, when $7,465.50 were expended removing these obstructions, the river being thus made navigable during high water, say three months in the year to Bevilport, and during low water to Weiss Bluff. The act of March 3, 1881, also provided for an examination or survey, to ascertain the practicability of a deep-water channel from Sabine Pass to Orange and Beaumont, and the estimate made in accordance with the provisions was as follows:

For a 6-foot channel	$21,000
For a 7-foot channel	42,000
For an 8-foot channel	149,713
For a 10-foot channel	377,804
For a 16-foot channel	1,350,000

It was noted in a report that the depth then existing (5 feet) was more than sufficient for all the requirements of commerce for many years to come.

By act of August 2, 1882, the sum of $5,000 was appropriated for continuing the improvement of the river, and in the annual report (1883) recommendation was made in the following terms:

"This amount is insufficient to produce a good channel at its mouth, and as this is the only place on the river really requiring improvement, it is thought best to hold this money until a further appropriation is made, then to cut a good channel, say 100 feet in width, and having 5 feet depth of water in it."

In the same report it was stated that the channel across the bar had again shoaled until only 3½ feet of water could be carried over it, the bar being about 2 miles in length and requiring redredging about once

in three years, for which to obtain the channel mentioned above the removal of about 40,000 cubic yards of material would be required, costing, at 30 cents per cubic yard, about $12,000.

No work except a resurvey was done during the last fiscal year, and the recommendation that none be attempted with the balance on hand is renewed.

CONDITION OF THE IMPROVEMENT.

The depth of water in the cut across the bar seems to be generally about 1 foot less than that in Sabine Lake in the vicinity of the outer approach, quite enough for present needs.

There is no commerce upon this stream below Beaumont with the exception of irregular trips of a small steamer to and from Sabine Pass, and as its draught is but 2 feet the natural condition of the Neches Bar gives all the water needed for it.

For several miles below the town of Beaumont the forest growth along the banks is so high as to exclude the wind from sailing-vessels to such an extent as to prohibit their use in the lumber trade without the assistance of tow-boats in this portion of their route, and, there being no tow-boat, no shipment is attempted.

Any improvement of the bar must then be supplemented by tow-boat service to be of any use whatever. Tow-boat service cannot be established and maintained unless the navigation over the bar shall be certain at all times. As any excavation through the bar will inevitably be filled up by deposits from the successive periods of high water, no relief other than the most transitory and unsatisfactory can result from dredging, unless indeed provision be made for keeping the bar dredged to the full depth required at all times and without fail. This course is, however, not recommended.

During the past fiscal year a resurvey of the bar at the mouth of the river was made. This channel has shoaled to 3½ feet of depth, and to deepen this channel to 5 feet would require the removal of 56,590 cubic yards of material at an estimated cost of $16,977.

The river is not susceptible of permanent improvement. With the money available from former appropriations we can, when it becomes necessary, deepen the channel over the bar. Until this balance is used up, no further appropriations are recommended.

Money statement.

July 1, 1884, amount available	$5,107	57
Amount appropriated by act approved July 5, 1884	7,000	00
	12,107	57
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	439	73
July 1, 1885, amount available	11,667	84

S 16.

REMOVING SUNKEN VESSELS OR CRAFT OBSTRUCTING OR ENDANGERING NAVIGATION.

(1) *Removal of wrecks in harbor of New Orleans, Louisiana.*—This work was in charge of Maj. Amos Stickney, Corps of Engineers, until July 23, 1884, and in charge of Capt. Thomas Turtle, Corps of Engineers, from that date until February 12, 1885, and in charge of Maj. W. H. Heuer, Corps of Engineers, since that time.

In reply to an advertisement inviting proposals for the removal of

these wrecks, opened July 14, 1884, three bids were received, which were rejected, being considered too high, and the work advertised under different specifications. Proposals under the new specifications were invited and opened August 30, 1884. These bids were again rejected, the conditions in specifications being considered illegal, and authority given to invite new proposals by circular letters addressed to previous bidders. In reply to these circulars bids were again opened on October 18, 1884, the lowest bid received being that of the Atlantic and Gulf Wrecking Company, of Somers Point, N. J., their bid being—

For removal of steamship Gresham	$16,000
For removal of ship Ailsa	5,500
For removal of steamship General Grant	6,000

This bid was approved and contract entered into November 13, 1884, and approved by the Acting Chief of Engineers December 26, 1884.

Work was commenced upon the removal of steamship General Grant during the latter part of November, 1884, and continued until January, 1885, when, on account of high water, work was suspended, and has not as yet been resumed for the same reason.

Amount expended during fiscal year ending June 30, 1885, $703.75.

(2) *Removal of steamer John M. Chambers from Bayou Teche, Louisiana.*—This wreck was in charge of Capt. Thomas Turtle, Corps of Engineers, until February 12, 1885, and in charge of Maj. W. H. Heuer since that date.

In accordance with law and instructions from the War Department, notice by advertising was given to all persons interested in the wreck of the steamboat John M. Chambers to have the wreck removed. The legal time of notice expired on February 9, 1885, and no action being taken, authority was asked to have this wreck removed by hired labor, using for the purpose the United States snagging plant at work on Bayou Teche. Authority being granted, work was commenced on April 1, 1884, under direction of First Lieut. O. T. Crosby, Corps of Engineers. The following is a copy of his report:

NEW ORLEANS, LA., *April* 13, 1885.

SIR: I have the honor to report as follows upon the progress made in removal of wreck John M. Chambers from Bayou Teche, Louisiana: The work was begun April 1. Two cypress trees which had lodged in the wreck, pieces of smoke-stack, two rudders, and other pieces loosened by a twenty-pound blast of powder, were removed before my arrival. On the 3d (Friday) I began breaking up the wreck with charges of Atlas powder, and continued this breaking up and removal until Saturday, April 11, when I returned to the city. Charges varying from 3 pounds to 28 pounds were used in cartridges varying from 2 to 25 feet in length, and having from one to six fuzes in circuit. The Laflin and Rand magneto machine, belonging to the United States snag-boat, was used for exploding the fuzes. The charge was made up without breaking the half-pound cartridges as supplied further than to split the paraffined paper with a penknife. These cartridges were laid in single or double file, with or without intervals according to strength required, and inclosed in a strip of rubber packingor cotton-duck. At first packing was used, and the edges stitched together in making up the charge, but after the first half-dozen blasts I used the duck, which was only tied around the cartridges at such intervals as to secure all in place.

The fuzes were placed at average intervals of about 4 feet. The joints were wrapped with cloths, then dipped in pitch. These joints were imperfect and caused a number of failures, requiring the charge to be taken up and refitted. They were probably water-tight when made, but if strained by the current or the sinking weights doubtless cracked. I had no rubber tape on the boat. When I left the work on Saturday, a portion of the sides and of the deck and hull framing amid-ships remained to be removed. This was, however, so broken up by blasts made on Friday that few others would be needed. The whole of the crew had grown familiar with the handling of the explosive, and Mr. Oliver, the overseer, has long been familiar with the use of gunpowder in submarine work. On the 15th, Wednesday next, he will probably have finished.

Much of the oak timber was so heavy as to sink if unsupported. This and all other débris was eagerly taken by men in skiffs, who were ever on the alert to pick up the material afloat or take from the snag-boat that which would otherwise be landed to prevent sinking. A good deal of time was thus saved; only a few pieces, too large to be handled by the skiffs, were landed by tackle ashore. The water around the wreck ranged in depth from 6 in-shore to 12 feet near mid-stream. Every blast made near the muddy bottom increased this depth from 1 to 2½ feet. The build of the *Chambers* was very strong; a multitude of bolts and many very heavy timbers were met. Two hundred pounds of "Atlas A" and 105 pounds of "Hercules No. 2" powder had been used when I left. A few more blasts will doubtless be made by Mr. Oliver to facilitate the completion.

The number of blasts was thirty-four; total length of charge, 500 feet; fuzes, total number, 110. The first order for explosives was for 200 pounds Atlas, 50 pounds Hercules, the latter being about 20 cents cheaper per pound. The second order was for Hercules alone. The heaviest work had been done, and furthermore, as in such uncertain conditions a surplus of power must generally be employed, it seemed proper economy to use the cheaper grade.

Very respectfully, your obedient servant,

O. T. CROSBY,
First Lieutenant, Engineers.

Maj. W. H. HEUER,
Corps of Engineers, U. S. A.

The amount expended in removing this wreck is $1,277.17.

S 17.

PRELIMINARY EXAMINATION OF HOMOCHITTO RIVER, MISSISSIPPI.

OFFICE UNITED STATES ENGINEER,
New Orleans, La., November 18, 1884.

GENERAL: I have the honor to submit the following report upon the preliminary examination of the Homochitto River, Mississippi.

The examination was made by Superintendent C. D. Anderson, who reports as follows:

About 8 miles above Fort Adams, the Homochitto (here called the "Narrows") enters the Mississippi, and runs nearly parallel with it for a distance of nearly 6 miles, to where it connects with and takes the name of "Old River." It is 150 feet wide at low-water mark for about 1 mile, 5 feet deep, has firm banks from 10 to 15 feet high with natural slopes, and requires very little work. It then gradually shoals and contracts until at about 2 miles it becomes impassable on account of shoal water. It then deepens again, and from there on there is sufficient depth of water, but the width is practically obstructed with snags, fallen trees, and overhanging willow trees whose tops almost meet in places, but can be easily cut up and floated away. The "Narrows" cannot be made navigable at low water without at least 1 mile of dredging and considerable work in removing snags and overhanging trees for the remaining distance to "Old River." It would appear but a question of a short-time when the lower half of the "Narrows" will merge into the Mississippi, the distance across from one to the other, in some places, being only a few hundred feet. And at one point immediately above the shoals the high water of the Mississippi, has made a serious encroachment in the form of a cut-off which would have to be closed. "Old River" is about 12 miles long, and in the shape of a horseshoe, from 1,000 to 1,200 feet wide, 15 feet deep, clear of obstructions, and is navigable at all times. Its banks are thickly settled and present an almost continuous cotton-field.

The soil is exceedingly fertile, but subject to periodical overflows, which occur usually in March and sometimes last until late in June.

Cotton is cultivated almost exclusively, and to the extent of about 5,000 bales annually. The most of this is brought out by a small steamer of 6 horse-power, which tows a couple of light barges, transporting forty bales three times a week down to McGill's Landing, about midway the Narrows, where it is hauled across the narrow strip of land and shipped on Mississippi River steamers. The freight charge is 75 cents per bale to McGill's and $1 from there to New Orleans, whereas if the Narrows could be improved there would be a saving of 75 cents per bale in transportation. So with cotton-seed and all supplies for the people.

At a point about 7 miles further up Old River the Homochitto proper enters from the northeast, and so far as I could ascend it in a skiff (about 2 miles) it was from 30 to 40 feet wide, very crooked, and filled with the most formidable obstructions, such as logs, snags, land slides, and fallen and overhanging trees. The farms extend but a short distance above where I went. A low, swampy country then intervenes and reaches to the hills, a distance of 8 or 10 miles. From this swamp a quantity of saw-logs are obtained, but the total amount of cotton and saw-logs furnished by this portion of the Homochitto would not justify the heavy expenditure that would be required to clean it out. As for the cotton, there is a convenient shipping point for that at the junction with Old River (Lake Mary Landing); and as for the saw-logs, inasmuch as they cannot be floated out of the swamp except at high water, they can be run down the river at the same time without the necessity of improving it.

Within this distance of about 15 miles there are six steam cotton-gins, and about the same number of gins that are run by horse-power.

To determine whether this water-course be "worthy of improvement" the report gives the following data: The products requiring shipment are about 5,000 bales of cotton and the cotton-seed corresponding, which, with the supplies required for the population cultivating a crop of this extent, have now to be towed on small barges for several miles, unloaded, hauled across the neck of land, and again loaded for final transportation. If larger steamers could reach the landings from the Mississippi the saving to this community would undoubtedly aggregate several thousand dollars per year. To provide the facilities a dredged cut would have to be made of about one mile in length, and perhaps periodically, and several miles of stream would require the removal of obstructions and overhanging trees. It being further considered that the conditions of the connection with the Mississippi River may shortly very seriously change because of the encroachments of the latter, I have to report that in my opinion the benefits would not bear a proper ratio to the expenditure, and that the stream is in that view not worthy of improvement.

Very respectfully, your obedient servant,

THOMAS TURTLE,
Captain of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

S 18.

PRELIMINARY EXAMINATION OF BUFFALO RIVER, MISSISSIPPI.

UNITED STATES ENGINEER OFFICE,
New Orleans, La., November 18, 1884.

GENERAL: I have the honor to make the following report on the preliminary examination of the Buffalo River, Mississippi:

Superintendent C. D. Anderson, who made the examination, reports as follows:

This river enters the Mississippi from the northeast 1 mile above Fort Adams, Wilkinson County, and as far as I was able to ascend it in a skiff (about 5 miles) I found it sparsely settled, a narrow, crooked stream almost completely choked with logs, snags, fallen trees, land slides, and drifts; also subject to overflows and without navigation of any kind. I learned that there was considerable cotton raised 4 or 5 miles farther up, and that a bridge had to be constructed at that point in order to reach Fort Adams from the west side. The production of cotton then increases, and some of it is

hauled in wagons a distance of 15 or 20 miles to Fort Adams, which ships annually about 5,000 bales and about 200 tons of cotton-seed. These constitute nearly the entire resources of the country, and I am satisfied that no practicable amount of improvement of Buffalo River could even be beneficial or permanent.

My opinion is that the river is not worthy of improvement, and I so report.

Very respectfully, your obedient servant,

THOMAS TURTLE,
Captain of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

S 19.

PRELIMINARY EXAMINATION OF BAYOU PLAQUEMINE, LOUISIANA.

UNITED STATES ENGINEER OFFICE,
New Orleans, La., December 5, 1884.

GENERAL: I respectfully submit a report upon the preliminary survey of the Bayou Plaquemine, Louisiana, made as required by the act of July 5, 1884. The examination was made by Mr. C. D. Anderson, and he reports as follows:

NEW ORLEANS, LA., *December* 3, 1884.

SIR: I have the honor to submit the following report on the preliminary examination of Bayou Plaquemine:

Beginning at what is called "New Levee," across the bayou about 300 yards below its connection with the Mississippi, the bed of the stream is nearly dry and thickly strewn with cypress saw-logs for a distance of 5 miles to Darden's Bend. From there, down 4 miles farther, to the mouth of Grosse Tête, there is sufficient width and depth of water, but it is covered with extensive rafts of saw-logs. The same may be said of the remaining 2 or 3 miles to Upper Grand River. These saw-logs are the only obstruction of any consequence throughout. Bayou Plaquemine has been given up entirely to the lumbermen, who have already stored it with a supply of logs sufficient to last them for several years; and, as this is the only interest to be served, there is no need of any improvement whatever.

The entire country, in all directions except the strip of high ground along the Mississippi, has been of late years several times inundated by the water which flowed through the crevasses of the Mississippi River, and, so long as the levees above continue to break, there is no hope of this vast and fertile territory ever becoming available for any purpose other than that of its almost inexhaustible supply of cypress and other valuable timber.

Very respectfully, your obedient servant,

C. D. ANDERSON,
Superintendent.

Capt. THOMAS TURTLE,
Corps of Engineers, U. S. A.

Surveys for a lock by which to make connection with the Mississippi River were commenced last year under the direction of the Mississippi River Commission, but are now, I believe, though incomplete, suspended. Should the Atchafalaya be closed, a connection with the Mississippi at this or some other point would be a very important matter for a large region of Louisiana, but, unless this connection be considered also, the improvement of the Plaquemine is of little consequence to the public.

I do not understand that the connection with the Mississippi is intended to be examined by the terms of the act of July 5, and I have therefore to report, this connection aside, that the Bayou Plaquemine is not worthy of improvement.

Very respectfully, your obedient servant,

THOMAS TURTLE,
Captain of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

S 20.

PRELIMINARY EXAMINATION OF ATCHAFALAYA RIVER, LOUISIANA, ABOVE BERWICK BAY.

UNITED STATES ENGINEER OFFICE,
New Orleans, La., November 20, 1884.

GENERAL: I have the honor to submit the following report on a preliminary examination of the Atchafalaya River, Louisiana, directed to be made by the act of July 5, 1884, and assigned to me by letter from your office dated July 31, 1884:

This examination was made by myself, passing over a route from Patersonville to the Red River. At present the Atchafalaya is used for water transportation and freightage from the Teche region, and from the Courtableau to New Orleans via the mouth of Red River, the Plaquemine being closed, and there is also a lumber trade in logs which reach Grand Lake from the bordering swamps and tributary bayous, and are taken to the Teche district in rafts.

On the Atchafalaya formerly there were numbers of plantations, but the enlargement at the head and upper portion, with the increased flow from the Red River and the Mississippi River, has caused the overflow of the entire region when these rivers are high, and the abandonment of the lands for cultivation has been the consequence.

A trade in wood for the use of steamers and for the New Orleans market, and in staves, seems to be the only industry upon the river front. The route is also valuable as a regulator of freight charges to and from the Teche, and the river is, in my opinion, worthy of improvement, and I so report.

The Mississippi River Commission have supervision of the regulations of the Atchafalaya and Red River connection with the Mississippi, because of its relation to the latter stream, and any regulations of the Atchafalaya below is intimately connected with the decision of the Commission. An examination has lately been made by them, but their policy, if decided upon, is not yet known. Pending their decision any present regulation can only be provisional, their possible conclusion being kept in view.

A tracing* is herewith to show the routes now taken in passing from the Upper Atchafalaya to Grand Lake. The Plaquemine connection with the Mississippi is also shown. When the stage of water permits steamboats passing down the Atchafalaya go through Bayou La Rompe and Mongoulois to Lake Chicot. If the stage be low this route is unavailable because of shallows at the Lake Mongoulois and of the La Rompe, and steamboats must take the much longer route through Grand River and Bayou Sorrel. My predecessor, Major Stickney, Corps of Engineers, in his Report estimates (see Report of the Chief of Engineers, 1882, Part II, page 1408) the cost of the improvement of the La Rompe at $38,734.

In September, 1881, the route at lowest water (see Major Stickney's report above referred to) was by way of Little Tensas, the estimated cost for clearing out the route being $23,160.

The estimate cost of cleaning out the route through Grand River and Bayou Sorrel, in the same report, was $92,604. Of this estimate $26,250 was for dredging through a log pile 1,000 feet long, which I presume is the obstruction in Bayou Sorrel Bay. To avoid this obstruction, the steamboat upon which I made the trip passed up through

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*Omitted.

Jakes and Rigarby bayous into Bayou Sorrel, the passage being somewhat impeded by overhanging trees and abrupt bends.

The route via Bayou La Rompe is undoubtedly available at a lower stage in its present condition than it was when examined in 1881, when "steamers could not pass except with a rise of 7 feet above low water." A survey would be necessary to again determine the cost of a complete improvement through this route and through that via Little Tensas.

Referring to the alternate routes, via La Rompe and Lake Mongoulois on the one hand, and that via Grand River and Bayou Sorrel on the other, Major Stickney (Report 1882, Part II, page 1409) has expressed the case thus:

> In case locks are constructed at the head of the Plaquemine to connect Grand River with the Mississippi, the route which would be used almost entirely would be down Grand River to the Plaquemine, and the Attakapas trade would go down Lower Grand River and Bayou Sorrel to Lake Chicot. The navigation by this route will be fully as good as that by Little Tensas. Though the cost of improving this route would be considerably greater than that of either of the other two, the fact that they would practically be of no account in case of a change to the Plaquemine connection with the Mississippi River might make it advisable to improve this longer route instead of either of the others, as the whole work would be necessary in case the change mentioned above was made.

The studies for the lock at the Plaquemine are in progress; the problem of the Atchafalaya, Red River, and Mississippi connection is under consideration, and when all this has been decided upon some time must elapse before the new conditions are worked out and the Plaquemine outlet provided. In the mean time the navigation can be materially benefited by the expenditure of a much smaller sum than any radical improvement would require. The operations would consist of the removal of snags and the cutting of overhanging trees, to include possibly clearing La Rompe, or Little Tensas, or Bayou Sorrel Bay, to be determined after examinations.

The following estimate for this provisional work is as follows, it being supposed that operations shall extend over two seasons in order that the expense of a proper plant might advantageously be incurred. Operating expenses being independent of the method used, this estimate will cover operations either by contract or hired labor, as may be decided upon:

Derrick flat, with boiler and engine and quarter-boat	$5,000
Operation expenses, ten months, at $1,000 per month, to provide for superintendent or inspector, as the case may be	10,000
For work in La Rompe, Little Tensas, or Bayou Sorrel Bay, as may be determined after examination	5,000
Total	20,000

The application of this sum will give the navigation substantial relief preliminary to work in La Rompe, or Little Tensas, or Bayou Sorrel Bay; surveys or examinations will be desirable, which, inclusive of the copy of maps pertaining to the Engineer Department files, and required in this office, I estimate will cost the sum of $1,500, which sum is recommended to be allotted from present appropriations.

When the decisions of the Mississippi River Commission with reference to the Atchafalaya, Red River, Mississippi connection and the Plaquemine are known I may have occasion to supplement this report by an additional one.

Respectfully submitted.

THOMAS TURTLE,
Captain of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

SURVEY OF ATCHAFALAYA RIVER, LOUISIANA, ABOVE BERWICK BAY.

UNITED STATES ENGINEER OFFICE,
New Orleans, La., March 18, 1885.

GENERAL: I have the honor to forward herewith the report of First Lieut. O. T. Crosby, Corps of Engineers, on the result of a hasty survey of the Bayou La Rompe, and Little Tensas, Louisiana. The object of the survey was to determine which of these two routes was the more desirable to improve, as well as to make an estimate of the cost of the improvement, with a view to give an unobstructed navigation route between the Teche and New Orleans at all seasons of the year.

It is reported that the richest sugar lands in the United States are situated on the Teche. The value of this product for last season is estimated at about three and one-third millions of dollars. To get this crop to market at New Orleans it must come by rail from the Teche, a distance of about 125 miles, or it can come by an all water route from the Teche into the Atchafalaya, Grand Lake, Lake Chicot, Lake Mongoulois, bayous La Rompe or Little Tensas into the Grand or Atachafalya river again, thence into the Mississippi, through Old River, to New Orleans, a distance by water of about 425 miles.

The railway rate on this sugar is said to be 20 cents per 100 pounds, or, say, $4.48 per ton; the rate by river is about 15 per cent. less, or, say, $3.81 per ton. Notwithstanding this difference in rates in favor of the river route, the latter only carries about 10 per cent. of the total product, the balance being carried by rail. Why the river route with its cheaper rate should only transport such a small percentage is not clearly manifest. There is ample depth of water to carry increased quantities, but it is believed that the planters prefer to pay the increased railway rate in consequence of the saving in time in getting their product to market. By the river route there is generally only business enough to support one steamboat the year round. If more business offered at paying rates there are plenty of steamboats that would compete for the trade. Should either the Bayou La Rompe or the Little Tensas be improved it is not at all certain, nor even probable, that the boat or boats would carry any more freight than at present, nor that the freight rates in consequence of an improvement would be in the slightest degree reduced. Looked at in this way, it is difficult to see what commercial advantages can result from an improvement of this navigation route. During low-water seasons the boat might make a little better time between terminal points, but the chief advantage is in the moral effect that a competing route is available.

The agents of the railway company assure me that the water route can have and does have no effect in regulating the freight rates between competing points on the Teche and New Orleans. This seems plausible when it is considered that the railway company carries 90 per cent. of the output of that section of the country.

The product of the Teche country (sugar and molasses) for the year 1883–'4 was about 34,000 tons, valued at about three and one-third millions of dollars; if, as reported, we assume 10 per cent. of this to have been marketed by boat, the saving to the shipper would have been 3,400 × .67 cent, or $2,378 in consequence of this transportation route.

The planters commence to ship this crop early in the winter, and by the middle of March following the crop is generally marketed. During this shipping season the river and bayous are generally in a good boat-

ing stage, and do not need any special improvement. During the summer, when these streams are low, the freight rates are about the same as in winter, and so little shipping is done at that season that if the rates were increased it would make but little difference at the end of the year in the aggregate amounts of freights paid.

To get into the bayous La Rompe or Little Tensas from New Orleans boats must pass into or out of the mouth of Red River. In low-water stages there is sometimes less depth of water at the mouth of this river than at the mouths of the bayous referred to.

Major Stickney, Corps of Engineers, who had until recently charge of the Atchafalaya River and of these bayous, caused instrumental surveys to be made of the river and bayous, and his estimate of the cost of the improvements of the La Rompe was $38,734.80, while that of the Little Tensas route he estimated to cost $23,160. Lieutenant Crosby, in his report herewith, estimates the La Rompe improvement to cost about $16,000, and the Little Tensas improvement to cost about $2,000; he also gives preferences and reasons for improving the La Rompe rather than the Little Tensas Bayou. The reasons for the discrepancies or large differences in these respective estimates are due to the difference in the character of the improvements designed, particularly with reference to the character of the dams projected to shut off the side bayous from the La Rompe. It is possible that those designed by Lieutenant Crosby may answer the desired purpose, but there is danger, in consequence of the immense volume of water from the Mississippi now flowing through the Atchafalaya, that if these side bayous be closed the river may break out above or below these dams, and cut new outlets when the old ones shall have been closed. When it is considered that at present this whole country near the La Rompe is about or nearly 8 feet under water, and that only occasionally rare small patches of land can be seen, it will not be at all surprising that the bayou should break its banks whenever they may happen to be weak. The bar at the mouth of the La Rompe, according to official reports (Major Stickney's, 1882), is supposed to consist of sunken logs, covered with Mississippi River mud; no estimate has yet been submitted for the removal of this obstruction. It is almost certain that should the dams be built on the smaller outlets of the La Rompe, and the banks *not break* above or below these dams, a scour will result and cause a deepening of the channel in the La Rompe, but this scour will in all probability not remove sunken logs from its mouth, and hence not improve the navigation to the extent desired.

Again, with the head of the Atchafalaya open and taking such an immense volume of the flow of the Mississippi River through it, it is not at all certain that any improvement made on the bayous La Rompe or Little Tensas will be in any sense permanent.

Major Stickney, in his report, printed in the Annual Report of the Chief of Engineers for 1882, Part II, page 1410, says:

> It is evident that no plan for improving the Atchafalaya, further than that already mentioned, is worth considering until something definite is done at the head, and as this is intimately connected with the Mississippi River problem, I have no recommendation to make until the Mississippi River Commission shall have taken action.

With these views I fully agree, and am of the opinion that neither the navigation nor commercial interests of the Teche country will be materially injured by deferring any improvement of the bayous La Rompe or Tensas until the much more important work at the head of

Atchafalaya shall have been disposed of. When this has been done, an intelligent, comprehensive estimate and project can be made for the La Rompe or Little Tensas if required.

Respectfully submitted.

W. H. HEUER,
Major Engineers.

The CHIEF OF ENGINEERS, U. S. A.
(Through Lieut. Col. D. C. Houston, Corps of Engineers, Supervising Engineer.)

[First indorsement.]

OFFICE OF SUPERVISING ENGINEER,
New Orleans, La., March 28, 1885.

Respectfully forwarded to the Chief of Engineers with my approval.

D. C. HOUSTON,
Lieut. Col. of Engineers, Bvt. Col., U. S. A.

REPORTS OF LIEUTENANT O. T. CROSBY, CORPS OF ENGINEERS.

1.

OFFICE UNITED STATES ENGINEER,
New Orleans, La., March 9, 1885.

SIR: I have the honor to report as follows upon a survey of bayous La Rompe and Little Tensas, made under orders from Capt. Thomas Turtle, Corps of Engineers, U. S. A., dated New Orleans, La., January 23, 1885. These orders required a determination of comparative cost and advantage of improving the two bayous named, and considered as navigation routes between Grand River and Lake Mongoulois, a part of the through route from New Orleans to the Teche. In compliance with further particulars of these orders, I went on February 1 to Raceland, La., joining there the snag-boat which had been working on Bayou La Fourche, and was now to be removed to Bayou Teche, serving *en route* as a quarter-boat for the survey. The tug engaged before I left to start on Saturday night did not reach the snag-boat until Monday, 6 p. m., having delayed its departure until Sunday afternoon. The up-trip was immediately begun, passing up the La Fourche into the Mississippi, on the Mississippi, through Old River into the Atchafalaya, down the Atchafalaya and Grand to Bayou La Rompe. The owner of the tug being unwilling to trust his boat and pilot on the Atchafalaya, it had been agreed that the tug should only give us a safe and convenient start down the Atchafalaya, the rest of the journey to be made floating with the current. Had existing conditions been known this would not have been attempted. It was accomplished with much labor and through some danger. We reached the La Rompe on the morning of February 10. The party consisted of Mr. Peter Oliver, suboverser, long in charge of the boat, five men of the crew previously working under him, and a cook. Among the men were some whose experience on former surveys fitted them for the rougher work, and one of them, Charles Johnson, served well as a rodman and leadsman. The whole country, save now and then a few feet along the banks of the streams, was found covered with water, frequently to a depth of 8 or 10 feet. The flood was roughly 10 feet above low water. The La Rompe, 9 miles long, is bordered by a dense cypress swamp, an edge growth of willow being generally found along the bank. It was impossible to use a transit or level in the ordinary way. By chance I had taken a pocket sextant by which horizontal angles were obtained. The telescope of the transit was separated from all its attachments, and when used with the stadium rested on a three-sided rectangular frame of wood, through the longer side of which a brad-awl was forced into a tree, thus giving support to telescope and frame. Little blocks were tied near the ends of the telescope, giving it a flat bearing on the short sides of the frame.

A circular board was attached to the lower leveling-plate of the level, giving a flat bearing on the tops of stumps of sawed-down trees. I sat in a skiff or on bending trees when taking readings. The difficulty of finding straight trees for furnishing good stumps as rests for the level and vertical surfaces against which the transit frame might be fixed caused the loss of much time. Distances were measured, in part, by triangulation, in part by direct stadia readings. Generally the leveling and stadia

rods were kept on one side the stream, instruments being on the other. Thus, the directly measured sides of triangles were those crossing the stream. Under such conditions, it will be understood that the survey was by no means an accurate one, but its accuracy is quite sufficient for the purpose in view, as is also its fullness of detail, I trust. No meridian lines were determined, those on the accompanying maps being taken from a low-water survey of the same region made some years ago. As soon as the boat had reached a stopping-place, February 10, I established three gauges, one near the boat, about midway between the head and mouth of La Rompe, one at its mouth, one at the mouth of Little Tensas. These were read as frequently as possible, though all could not be read every day. Fortunately, there was almost no change of stage during the first week's work, and a very regular and gradual one later. Another gauge was formed at the head of La Rompe. Readings were had from this also, and, indeed, this gauge, with information kindly furnished by Mr. Waterhouse, a resident there, furnished data for fixing a zero for level and sounding readings. The boat remained on Bayou La Rompe fifteen days, changing its position twice. Several days were lost on account of rain, and during the greater part of the working time the weather was very disagreeable by reason of cold mists. The Little Tensas was reached by skiff from the quarter-boat, which did not go nearer to it than the mouth of La Rompe.

BAYOU LA ROMPE.

From the accompanying map it may be seen that this bayou is about 9 miles long; is of sufficient width and depth throughout, save across a bar formed at its mouth. Nineteen hundred feet below the point of its departure from Grand River La Rompe receives the Little Atchafalaya, its principal affluent. Within the next $2\frac{1}{2}$ miles three small bayous flow in, Sunlight, Spoiled, and Runion.

Area of section of mouth of Little Atchafalaya is 2,447 square feet; that of the others, 495, 492, and 1,000 square feet, respectively. In Spoiled Bayou the current is scarcely perceptible. Near the head of the third mile is found Bayou Upper Glenn, which returns about half a mile lower down. Its section area at the head is 350 square feet; at the mouth, 1,012 square feet. After leaving the La Rompe it connects with some of the lake and bayou waters to the west, probably an outflow from the Little Atchafalaya, above its junction with the La Rompe. This relation of section areas may not be maintained during low water.

A few hundred feet lower down is found the head of another outlet, Bayou Lower Glenn, having a section area of 1,197 square feet. Its course is short, its waters being received by Lake Long, the largest outlet found. Its head is near the beginning of the fourth mile. and has a section area of 3,954 square feet. About $1\frac{3}{4}$ miles further down is found Devil Chute, a connection between La Rompe and Big Tensas. The La Rompe loses a considerable amount of water through the chute, which has a section area of 2,816 square feet.

Two other outlets, near the beginning of the seventh mile, have section areas of 784 and 723 square feet. One of these, Pisant Bayou, returns to the La Rompe under the name of Pisant Bay, about 1 mile further down-stream, the other, Drift Bayou, joining it before its return. The current in Pisant Bay is much less swift than that going out through Pisant Bayou and Drift Bayou; its section area is 1,123 square feet, showing, therefore, a considerable loss of water as compared with that taken off by the two bayous. Opposite the mouth of Pisant Bay begins that shoaling in the La Rompe which obstructs navigation. An inspection of the 5-foot curve, traced on accompanying chart, discovers two stretches, one of 1,100, the other of 1,000, feet, along which a less depth than 5 feet was found. One of these stretches is beyond the mouth of the La Rompe, but between the lake shore and Cow Island, which is a comparatively recent bar formation, now covered by a growth of young willows. Only such part as could be seen during the high stage of water maintained during the survey is represented by the shore-line drawn. At low water about twice the length represented is seen, a fact made evident by the soundings. I judge that this island or bar is still growing longitudinally, since the willows on the outer end are younger than those on the inner. A shallow channel is still seen between the inner end of Cow Island and the left, or east, point of the mouth of La Rompe. The water along this line is almost without motion.

To obtain a depth of 5 feet over the bar within the La Rompe and beyond its mouth to deep water shown by the soundings, and throughout a width of 60 feet, the removal of about 250,000 cubic feet of earth will be required. This removed material must be carried an average distance of three-quarters of a mile before reaching the deep water and swift current found in the narrow portion of the lake, as shown on the chart. To effect this, and also to prevent further deposit in the same neighborhood, I think the following work sufficient: A closing of Lake Long, Bayou Lower Glenn, Devil Chute, Pisant Bayou and Bay, Drift Bayou, and the channel between Cow Island and Fine Point.

The closing of the latter would practically change the mouth of La Rompe, plac-

ing it at the outer end of Cow Island and quite near the swift, deep, lake currents before mentioned. The closing of the outlets would, I think, fully double the output at the mouth. The closing of Pisant Bay would prevent a spread of the waters there when, on account of the closing of bayous Pisant and Drift, there would be no inflowing current. The current now is scarcely perceptible at high water, and I believe is less at low water. I cannot make any close calculation as to the gain in output, because I have no velocity measurements; these were not attempted because I believe that on account of the flood the velocity relations were so different from those maintained at ordinary stages as not to be serviceable. The outlets might be economically closed by brush-dams not perfectly impervious to water. I would suggest dams constructed by driving across each stream near its head three lines of piles to a depth of from 6 feet to 20 feet, according to depth of water, and at intervals of 4 feet, center to center, lines 10 feet apart. Between the piles of each line small willows to be woven thickly; between each two rows brush to be packed as tightly as possible and held down by horizontal topping pieces, the heads of the piles to be 6 feet above low water.

To assist these constructions the timber should be felled down-stream, choking it, this choking to begin a short distance below the dam so that the piling of the water due to fallen timber would diminish pressure against the dam. The few spots of land visible showed by irregularities that the material carried is readily deposited, every chance obstruction having caused a considerable mound and corresponding depression. The willow islands at the mouth of this and other bayous flowing into the lake are also growing rapidly; I therefore believe that the construction suggested would be efficient to completely close the outlets in one or two seasons. It is probable that a bar would soon form across the mouth of Pisant Bay, but, were the work undertaken, the process should be hastened by placing some sediment-catching device of light character along the line desired as a new shore line.

The channel between Cow Island and the point seems also to be diminishing its cross-section, but should be stopped artificially. As the current is almost imperceptible and the water shallow, a light brush construction will be sufficient.

In all about 700 piles would be required; unless a large sum should be expended for plant the whole work can be done for about $16,000. The pile-driver and quarter-boat now on Bayou Courtableau might be easily transferred to this work. Piles and brush are to be had on the ground.

BAYOU LITTLE TENSAS.

At present there is a 5-foot channel throughout this bayou and the bay, into which it broadens about a quarter of a mile above its mouth. The width, while sufficient, is in some places inconveniently small. The cutting down of about one hundred bordering trees would effect an improvement in this respect. I was told by Mr. Waterhouse that many stumps are in the channel. These I could not locate. They are probably most numerous in the bay. Soundings in this bay show scant 5 feet over a part of the course. Soundings in the lake near the mouth of Little Tensas indicate that there is danger of losing the present 5-foot channel. Two other bayous enter the lake near this, and their bar formations are advancing toward its mouth. One line of soundings not far distant from the mouth shows a scant 5-foot channel. Considering this, however, as sufficient, there is now nothing to be done for the improvement of Little Tensas save the cutting down of trees and pulling up of stumps. As the whole length of the bayou is about 3 miles, and a large part of this is certainly clear, I think $2,000 as much as could profitably be spent on this stream.

COMPARISON OF THE TWO ROUTES.

The La Rompe offers a route shorter by about 4 miles than that given by Little Tensas, a difference of about $250 per year in the running expenses of the boats now regularly plying to the Teche. There is less danger of accident in the La Rompe, as it is wider and straighter. Its course across the lake can be directed toward the southern outlet, Bayou Chene, in such manner as to prevent the formation of bars. Should the shoaling in front of the mouth of Little Tensas continue, as it now promises, only a very large expense could rectify matters. Two other streams affect quite considerably the lake currents near the mouth of Little Tensas, and there is a much broader, shallower, and longer area of lake between it and Bayou Chene than between the latter and Bayou La Rompe.

Looking to probable future changes, as now indicated, I would recommend the improvement of La Rompe rather than Little Tensas. Considering the present only, this recommendation would be reversed. A few years, perhaps the next low water, may develop new difficulties in the Tensas route. The difficulties in the other will change in degree, scarcely in nature.

Very respectfully, your obedient servant,

O. T. CROSBY,
First Lieut., Engineers.

Maj. WILLIAM H. HEUER,
Corps of Engineers, U. S. A.

2.

OFFICE UNITED STATES ENGINEER,
New Orleans, La., March 17, 1885.

SIR: I have the honor to make a report, supplementary to that concerning a survey of bayous La Rompe and Little Tensas, of facts showing the commercial interest involved in the question of improving the route from New Orleans to Bayou Teche.

From the Louisiana Sugar Report, 1883–'84, I find the following figures:

Sugar raised in Teche parishes	pounds..	46,905,600
Molasses raised in Teche parishes	gallons..	2,532,870
46,905,600 pounds sugar averaged 5 cents		$2,345,280
2,532,870 gallons molasses averaged 40 cents		1,013,148
		3,358,428

Although some rice is raised in the same section, the figures above may be fairly taken as representing the output of the Teche country. No figures are at hand showing the value of articles imported into the section, but it may be taken as large, since the people raise little else than sugar.

Statements from railroad and steamboat sources agree in showing that at present the Morgan Railroad, running through this Teche country, handles about nine-tenths of the freight. The railroad men further hold that on account of the length of water route no boat can live in the trade should the road determine to crush it. Several gentlemen of this city, largely interested in the sugar trade, assert, however, that the existence of the water route is a very valuable protection against extortion on the part of the railroad, and consequently desire an improvement of that route as affording a better protection. They also prefer the steamboat as having a much more convenient point of delivery in New Orleans and as taking better care of live stock while *in transitu*.

Since my return one of the officers of the New Iberia, the only Teche packet now regularly running, informs me that, as was suggested in my report, stumps and logs are found only in the bay of the Little Tensas route, while overhanging trees give some trouble in the narrow parts. He further informed me that the obstruction at mouth of Old River sometimes prevents entrance, but that the most frequent trouble occurs in that part of the route under consideration.

Very respectfully, your obedient servant,
O. T. CROSBY,
First Lieut. Engineers.

Maj. WILLIAM H. HEUER,
Corps of Engineers, U. S. A.

S 21.

PRELIMINARY EXAMINATION OF BAYOU PIERRE, MISSISSIPPI.

OFFICE UNITED STATES ENGINEER,
New Orleans, La., October 27, 1884.

GENERAL: I respectfully submit the following report of a preliminary examination of Bayou Pierre, Mississippi, made as required by act of July 5, 1884. The examination was made by C. D. Anderson, superintendent, and the following is his report:

NEW ORLEANS, LA., *October* 16, 1884.

CAPTAIN: I have the honor to submit the following report of a preliminary examination of Bayou Pierre, Mississippi:

From the bridge of the Mississippi Valley Railway, across the bayon near Port Gibson, for a distance down stream of 5 or 6 miles, the stream is extremely shallow and tortuous, full of obstructions, such as logs, snags, and accumulated drift, rendering it very difficult to proceed with a skiff, and then at the rate of not more than 1 mile an hour. The depth of water then increases gradually, and the obstructions diminish for 10 or 15 miles farther to the mouth of Widow's Creek, which is 10 miles from the mouth and about 6 miles by land and a good road from Port Gibson. At the

mouth of this creek there is 7 feet of water, and allowing 2 feet for backwater now coming up from the Mississippi River, will give a permanent depth of 5 feet. From this point down the depth of water continues to increase until at the mouth there is from 20 to 30 feet. In this distance of 10 miles the obstructions are comparatively few, and may be easily removed, while there are many fine reaches a mile in length and easy curves with one exception, and at this there is ample room and depth of water for any ordinary steamer to turn. The area of cross-section will average about 100 feet at the bottom or low-water line, and about 300 feet at the top, and there are very few overhanging trees which need to be disturbed. The banks will avêrage 15 or 20 feet in height, but are overflowed to some extent in time of unusual high water in the Mississippi.

Bayou Pierre from its mouth to Widow's Creek can therefore be made permanently navigable, with a depth of 5 feet at the lowest stage, and at comparatively little cost.

From there on up the logs, snags, and drift could be cut up and burned during the dry months of July, August, and September, and for the balance of the year, or for eight months anyhow, the backwater from the Mississippi could be relied on to float any vessel drawing 5 feet in safety to the railroad bridge and even to the landing at Port Gibson.

There have been no boats on this stream since 1867; but previous to that time steamboats with a capacity for 2,500 bales of cotton often came to Port Gibson, and immediately after the war Government transports ran up this far.

The country on both sides is under cultivation, cotton being the principal product, and of superior quality. Along the lower portion of the bayou considerable cypress and white oak is taken out. The extent of country tributary to this bayou, and which would be benefited by its improvement, embraces about 200,000 acres of what is claimed to be the best cotton land in the South.

The commerce of this region amounts now to at least $2,000,000, of which Port Gibson receives about one-half, the other half having been diverted to other points by railroads. No doubt the greater portion of this lost trade would be restored by the improvement of Bayou Pierre, as the people generally prefer shipping and receiving freight by water on account of the economy.

Port Gibson has an oil-mill in operation, with a capacity for crushing 4,500 tons of cotton-seed annually, and also a cotton factory of 3,300 spindles soon to commence operations.

There is a steam cotton-gin on the White Hall plantation, near the mouth of the bayou.

Very respectfully, your obedient servant,

C. D. ANDERSON,
Superintendent.

Capt. THOMAS TURTLE,
Corps of Engineers, U. S. A.

From the information here obtained and presented, I believe Bayou Pierre to be worthy of improvement, to the extent of removing the sunken logs, snags, overhanging trees, &c., mentioned as obstructions to navigation, and I would recommend that a survey of the bayou be made. For the improvement which seems at the present desirable, I think an instrumental survey not necessary, and I would limit the examination to an enumeration of the obstructions to be removed for the purpose of making an estimate of cost for the information of Congress.

The cost of such examination as is here recommended would, I estimate, not exceed $250.

Very respectfully, your obedient servant,

THOMAS TURTLE,
Captain of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

EXAMINATION OF BAYOU PIERRE, MISSISSIPPI.

This work was in charge of Capt. Thomas Turtle, Corps of Engineers, until February 12, 1885, and in charge of Maj. W. H. Heuer, Corps of Engineers, since that time.

In compliance with section 9 of the river and harbor act of July 5, 1884, the following examinations of Bayou Pierre were made.

The first examination was made under the direction of Capt. Thomas Turtle, lately in charge of the work, by his assistant, Mr. C. D. Anderson. * * *

As no estimate accompanied the report, and the work was transferred to my charge, I concluded to make a personal examination before making any recommendation or attempting any estimate of the cost of the improvement. A personal examination of the bayou from its mouth to the railroad bridge crossing near Port Gibson, La., was accordingly made on June 23, 1885. Port Gibson, Miss., is situated on one of the forks of this bayou, the other fork joining this one a few miles below Port Gibson, and the two then form what is known as Bayou Pierre, which extends from the neighborhood of Port Gibson in a circuitous course to the Mississippi River, into which it empties at what was formerly known as Brunnisburg Landing, Miss., a distance by bayou from Port Gibson of about 20 miles, more or less.

Before and during the war Port Gibson was a thriving town, and handled all the cotton for shipment that was grown in that section of the country, and which at that time is said to have exceeded 15,000 bales per annum.

Steamboats formerly ran there, and one went up the bayou as late as 1876. Tug-boats occasionally come into the bayou for 10 or 12 miles above its mouth, and one has been in the bayou within the past year to tow up a coal barge to one of the plantations. The bayou is liable to freshets, and during such freshets an immense quantity of drifts—log, trees, &c.—is carried down the stream, tearing away portions of its banks, and carrying away additional trees, some of which lodge in mid-stream and others fall in from either bank, forming obstructions and rendering the bayou almost impassable except for skiffs. Bars form around these sunken logs, and were there an ample stage of water in the bayou, on account of the obstructions in the stream it would be impossible for even the smallest steamer to navigate the bayou more than 10 or 12 miles above its mouth. What the rates of freight on cotton were by boat from Port Gibson via Bayou Pierre to New Orleans I could not ascertain. People were getting extraordinary high prices for their cotton, and did not care much what the freight rates were; in fact, I was assured they did not even ask about freight rates. Then the boats ceased coming, possibly on account of the bad condition of the bayou, and a short railroad, 7 or 8 miles long, was built to Grand Gulf, a landing on the Mississippi River. The freight rates on cotton shipped by this route to New Orleans were about $2 per bale, of which the railroad company got about one-half; the steamboats running from there to New Orleans, over 200, miles by water, got the other half. Then a railroad was built from Vicksburg to Port Gibson, and finally, less than two years ago, was extended to New Orleans. This road also purchased the short line to Grand Gulf and ceased to operate it. This road is reported to charge for carrying cotton from Port Gibson to New Orleans $1.75 per bale, while the river rate or railroad rate from Vicksburg, 30 miles farther from New Orleans by rail, is reported to be only 65 cents per bale.

The consequence is, as there is no other way to get products into and out of Port Gibson except by this railroad route, the merchants and planters here have to pay more than double as much for freights as those in other localities having competition or water transportation. As a result, Port Gibson has declined in prosperity, and much of her trade has sought more favored localities. It is for these reasons that the peo.

ple in the vicinity of this town desire to see Bayou Pierre reopened, thinking that some, at least, of their former prosperity may be restored to them.

At Port Gibson during low-water stage the bayou is about 60 or 70 feet wide, and is hardly capable in places of floating a skiff, but in freshets the bayou has risen at this point as much as 27 feet, and then becomes almost a torrent. The road is crossed by a suspension wagon-bridge roadway 27 feet above surface of water at low stage. For 4 or 5 miles below this bridge the bayou is very crooked and shallow, in fact not navigable except for skiffs. At this point, about 2 miles below Port Gibson by land, about 5 miles by bayou, the bayou is crossed by an iron railway bridge, whose roadway is about 30 feet, more or less, above the surface of low water. The bridge has no draw in it, and only last winter another wooden bridge in the same locality was undermined and washed away during a freshet. In the next 3 or 4 miles below the railway bridge the bayou widens a trifle, but is very crooked and shallow, having at present stage a least depth of 2 feet in it, and is so obstructed by snags, drift, sunken logs, and bars that it is unnavigable for anything much larger than a skiff; besides, some of the bends are so sharp, that were the obstructions removed it is doubtful if a small steamer could make the required turns. For the next 6 or 7 miles lower down the bayou is in better condition so far as bends and obstructions are concerned; but in this distance there are over five hundred leaning trees, about thirty fallen trees, eighteen or twenty visible snags, and about ten piles of accumulated drift, which would have to be removed to make the stream apparently navigable. It is also probable that the amount of sunken logs—of which no part was visible at the present stage of the bayou—that would have to be removed to make good navigation, would largely exceed the number of visible snags. The least depth of water found in this stretch of bayou was 5 feet, but this was because the bayou was not carefully sounded, and, moreover, was due to backwater coming up the bayou from the Mississippi, which was said to be 30 feet above its lowest-water stage. What the actual condition of this part of the bayou would be at extreme low-water stage of the Mississippi, and no freshet in the bayou, can only be conjectured. Boatmen tell me it is impassable for a skiff.

In the next 10 or 12 miles, which carries us down to the mouth of the bayou, the stream varies from 150 to 200 feet in width; the top of the banks are from 7 to 10 feet above the surface of the water; the banks and shores are densely timbered; there are no very sharp bends, and an ample depth of water at low stages for navigation purposes. There are a few ledges of soft rock cropping out of both banks which probably extend across the bottom of the bayou, but as the depth of water over them at ordinary stages is ample, they are not obstructions to navigation. In this stretch of bayou there were counted sixty-nine snags, logs, fallen and overhanging trees to be removed. With these out of the way there would always be good navigation up to the mouth of Widow's Creek.

Dividing the bayou up into sections, calling the first, 10 miles above the mouth, the lower section; the next 7 miles the middle section; and that portion above, 3 or 4 miles, up to the railroad bridge, the upper section, it can be seen that at the present stage of water in the Mississippi there is ample depth of water to float a steamboat up to the head of the middle section. This stage of water, it is said, can be counted on for from five to six months in the year, and would only require the re-

moval of six hundred to seven hundred of such obstructions as are mentioned in this report. It is difficult to make a close estimate of the cost of removing these obstructions, but judging from another work of similar character which we are doing by hired labor in Louisiana, I estimate the cost of this work approximately at $20,000. If the lower sections only were improved it would not be of much benefit to Port Gibson and vicinity, for the reason that the planters living in this section now ship their cotton and get their supplies via nearest landings on the Mississippi River, and the hauling of cotton and supplies from the head of this section to Port Gibson overland on such miserable roads as are found would cost nearly or quite as much as to haul them to and from the Mississippi River. The middle section, if improved, would enable boats to come to within about 4 or 5 miles of Port Gibson, and only require a cartage of about this distance for cotton and supplies to find water transportation.

Assuming the rate of freight to New Orleans by water transportation with the bayou improved to the head of the middle section of the bayou to be the same as it now is from Vicksburg, say 65 cents per bale, it becomes a question to the merchant of what it will cost to carry cotton and other freight in carts over 4 miles of miserably poor roads to find water transportation. If it costs $1 per bale to cart this freight, nothing is saved by improving the bayou; if it costs less, the difference between the cost of cartage and $1 per bale is the amount of benefit that ought actually to accrue to the merchant or planter.

The upper section of bayou cannot be improved except by dredging and snagging, and at a very great expense. It is roughly estimated that to cut a channel 40 feet wide by 5 feet deep in this additional 3 miles of bayou will cost over $30,000. The dredged material would have to be carried on top of the high banks at great expense, and it is believed that the bottom of the bayou in this upper section is a network of snags.

The estimate is probably under what it would actually cost to make the channel navigable, and if it were made navigable over this stretch to the railroad bridge it would still require about 2 miles of cartage to reach water transportation. If any of the improvements herein outlined were made it would only afford navigation for from six to eight months in the year and be dependent upon the present stage of water in the Mississippi River. Assuming it to be a fact that an average of 10,000 bales of cotton are handled annually at Port Gibson and that the return freights in the way of supplies are fully as great as the out put, this would make the freight handled here the equivalent of 20,000 bales of cotton.

With water competition to Port Gibson it is barely possible that the freight rates might be reduced $1 per bale, but it is more probable that this reduction would not be less than 50 cents per bale. On this basis the saving on freight alone would be $10,000 per year. If the estimated cost of the removal of the obstructions mentioned in the two lower sections, viz, $20,000 be correct, and it is believed that the estimate is liberal, then it seems to me that the improvement would add greatly to the prosperity of Port Gibson, in fact to all that portion of Claiborne County, Mississippi, bordering on the bayou. In this connection it seems to be eminently proper that as the portion of the bayou examined for improvement lies entirely within the county, that the county or State of Mississippi would be justified in making the improvement instead of asking the United States to do it for them.

From the examination and facts stated I believe the bayou to be worthy of improvement to the extent of removing the obstructions in its lower two sections, or say 16 miles above its mouth, at an estimated cost of $20,000.

The improvement, if made, will be of local benefit only, will not be permanent, ought not in my judgment to be considered a National work, and is certainly not a public necessity. No survey is required.

I append a table of statistics furnished by the members of the board of mayor and aldermen of Port Gibson, Miss.

Respectfully submitted.

W. H. HEUER,
Major of Engineers.

To the CHIEF OF ENGINEERS, U. S. A.

STATISTICS.

We, the undersigned members of the board of mayor and aldermen of the town of Port Gibson, county of Claiborne, State of Mississippi, learning that you are here under instructions of the Government to make examination of the Bayou Pierre, and to make report of the practicability and cost of making said stream navigable from said town to the point where the same empties into the Mississippi River, a distance of from 25 to 28 miles, would respectfully ask that you forward with your report the following table of statistics, to wit:

(1) Said town of Port Gibson was incorporated as early as 1803, and is situated on the banks of said bayou 8 miles due east from the Mississippi River, and 25 or 28 miles from the mouth of said bayou. In 1832, by act of Congress, it was made an entry port, with Natchez as a central office for the collection of customs. From the time it was declared a port of entry, until its connection with Grand Gulf, on the Mississippi River by railway in 1857, a large number of side and stern wheel steamers, together with scows and flat-boats, made regular weekly trips up the Bayou Pierre to said town, for from eight to nine months during each year. The records at Washington ought to show the port collections if they have been preserved.

(2) Said bayou was declared a navigable stream by act of Congress in 1787 and again in 1798. In 1817 the date of the admission of Mississippi as a State into the Union, Congress specially reserved exclusive jurisdiction over all navigable streams in said State, which were so by nature and which had been declared such by previous acts of Congress. Under various acts of the Legislature from 1829 to 1841, said bayou was kept opened and cleared of obstructions. And, in 1841, part of the fund arising from the 500,000 acres of lands, made by Congress for internal improvements was applied to this purpose. During all this time the entire trade of the town of Port Gibson and the country for 50 miles east of it for eight or nine months in the year was carried on by the boats plying between said town and the mouth of said bayou. The construction of the Port Gibson and the Grand Gulf Railroad suspended this trade in 1857. During the late war iron-clad gun boats steamed up said bayou to within 3 miles of said town, and successfully encountered a land battery planted on the Sprott bluffs, just below the railroad bridge.

(3) The Port Gibson and Grand Gulf Railroad has within the last three years ceased to operate between this place and Grand Gulf, having been absorbed in the Louisville, New Orleans and Louisiana Railroad Company. The bayou now needs cleaning out. If this be done, and it be kept open, water competition will give the people of said town and county a sure means of forcing cheaper transportation, while it increases the market conveniences of the people more than 100 per cent. The Bayou Pierre, formed by the confluence of its North and South forks, flows between Port Gibson and the Mississippi River. From the junction of its fork to its mouth it is not fordable at any season of the year, nor is there any but a railroad bridge across it. Even if there were, there is now no landing on the Mississippi River accessible, by wagons or railroads, from the mouth of the Big Black River to the mouth of the Bayou Pierre. Thus the advantages of the Mississippi River, 8 miles west of the town, are lost to us.

(4) Said Bayou Pierre has its source in Eastern Copiah County and drains a large area of country between the Pearl and Mississippi rivers. Following its meanderings it has a flow from its source to its mouth of nearly 150 miles. Two miles from Port Gibson it divides into two forks. The North Fork is the larger of the two and can

easily be made navigable from the Mississippi to "Grind Stone Ford," a distance of about 40 miles following the courses of the bayou. It flows through a rich and productive country. The South Fork flows to Port Gibson and can be made navigable to said place for eight or ten months in the year, especially as the back water from the Mississippi fills the bed of the same to the depth of 8 or 10 feet for five or six months in the year. Below its forks the bayou is watered by many small tributaries, and above its forks various streams flow into it from the north and south sides.

(5) The county of Claiborne has an area of 450,000 acres. All of this territory is affected directly and indirectly by the Bayon Pierre and its two forks. About 150,000 acres of it is open land, while the timbered lands afford material of great commercial value, which can find no highway to market, except through water-crafts, and down said bayou and its forks. The population of said county of Claiborne is about 18,000, and of said town about 1,500. The assessed valuation of the real and personal property, as shown by last assessment, is about $2,000,000, while that of said town is about $500,000. There are 1,800 farms in said county with about 130,000 acres of improved land, while the value of live-stock reaches about $500,000. The estimated value of all products is about $1,100,000. Two railroads, to wit, the Louisville, New Orleans and Louisiana Railroad, and the Natchez, Jackson and Columbus Railroad pass through the counties. The first is a trunkway with a monopolistic power, which the directors are using to the disadvantage of trade in said county by discriminations. It costs, for instance, to secure the transportation of one bale of cotton to market over this route $1.75, while it never cost by the Grand Gulf route before the construction of said road more than $1.50, and sometimes as low as $1. From Vicksburg, which is 30 miles further from the market, they ship cotton from 65 cents to $1. The Natchez, Jackson and Columbus Railroad is a local route, connecting at Harriston in Jefferson County with the New Orleans and Louisiana Railroad, and at Jackson, in Hinds County, with the Illinois Central. Thus competition is throttled, and our people are compelled to submit to unreasonable exactions. The opening of the Bayou Pierre will enable us to bring to our assistance the natural avenues of trade, and will enable us to procure better terms for the transportation of our products and commercial exchanges.

(6) The town of Port Gibson is the county site of Claiborne, and stands at the head of navigation of the South Fork of Bayou Pierre. It is an important trading point, with 29 business houses, in full operation. It draws to it trade of adjacent countries, with some little from the State of Louisiana. Its merchants do an aggregate business annually exceeding $1,000,000; and pay for freight brought over the various routes, to say nothing of passenger fare, nearly $40,000 per annum. It ships between 10,000 and 15,000 bales of cotton, besides small quantities of other produce. And its total transportation takes of every nation, including travel and shipments to and from same, aggregate close to $60,000. It has two thriving colleges with an attendance of from 50 to 100 students, to say nothing of its fine common schools, with almost as large an attendance as said colleges.

There are 8 churches representing nearly every denomination, with a synagogue in contemplation. Its residences are numerous, comfortable, and well kept, with paved, shaded streets, handsome yards, and gardens.

(7) In addition to the trade which would find passage over said bayou, from said town, and from the county at large, the future growth of the town, coupled with a large cotton-seed oil mill now engaged in successful competition with other mills in this and other States, and with a magnificent cotton mill, the buildings of which are now receiving the machinery, there can be no doubt but that the Mississippi River packets will enter boats in the Bayou Pierre, the moment it is declared navigable, to compete with our railroads for the trade of Port Gibson, and the country adjacent thereto.

Respectfully submitted, with the earnest request that you embody this statistical grouping of facts, connected with the subject of your investigation, in your report to the Department under the instructions of which you are acting.

[SEAL.] JAMES WETERSON,
Mayor of Port Gibson, Miss.
L. T. NEWMAN,
WM. CAHN,
JA. SHREVE,
JAS. MCRA,
Aldermen.

To Maj. W. H. HEUER,
United States Engineer.

S 22.

PRELIMINARY EXAMINATION OF NATALBANY RIVER, LOUISIANA.

OFFICE UNITED STATES ENGINEER,
New Orleans, La., November 6, 1884.

GENERAL: I have the honor to submit the following report of the prelimary examination of the Natalbany River, directed to be made by letter from your office dated July 31, 1884, in accordance with the requirements of the act of July 5, 1884.

A report upon this stream was made to the Department by Maj. Amos Stickney, Corps of Engineers, dated June 12, 1884, in which the estimated cost of removing the obstructions to the town of Springfield is given as amounting to $1,800.

The recent examination was made by C. D. Anderson, superintendent, and is as follows:

MOUTH OF TCHEFUNCTI RIVER,
October 29, 1884.

SIR: I have the honor to state that I have made the examination of Natalbany River, and respectfully submit the following report:

At 2 miles from the mouth of Tickfaw the Natalbany enters from the eastward, and for a distance of 10 miles will average 200 feet wide, 20 feet deep, is clear of obstructions to navigation, and needs no improvement. The low swamp land extends across on the west side to the Tickfaw River and on the east side to the Jackson Railroad, and is inundated by tide-water. The only industry throughout this extent consists in getting out shingles, staves, moss, and cord-wood. A few low spurs of dry land now extend to the river's edge and connect with pine timber, from which a large quantity of saw-logs are obtained. Along here for a space of one-fourth of a mile it is said that during the war a number of trees were felled into the river from both sides, to prevent the advance of gunboats, but I was unable to find them, the tide being at flood. About 3 miles further, to Springfield, the river will average 100 feet wide and 14 feet deep.

Obstructions, such as snags, sunken logs, fallen trees, and overhanging trees, also appear, but they are neither numerous nor formidable, and can be cleared out at slight cost.

Springfield is practically the head of navigation. There is a wooden bridge one-fourth of a mile above, on the main road to Ponchatoula; and between Springfield and the bridge, although the depth of water is sufficient, the river is so narrow, crooked, and full of obstacles as to render it unworthy of further attention.

A few schooners, drawing 4½ feet and 5 feet, ply regularly between Springfield and New Orleans, carrying down cotton, wool, moss, spirits turpentine, rosin, tar, shingles, staves, wood, hides, tallow, beeswax, vegetables, poultry, and eggs, which, with saw-logs, constitute a trade of about $75,000 annually. These vessels return with supplies for a large proportion of the inhabitants of East Livingston, South Saint Helena, and Southwest Tangipahoa parishes. Of course the Jackson Railroad has taken away a great deal of trade which would return to the Natalbany River should steam navigation be restored, as the difference in freight tariffs would be at least 50 per cent. in favor of the latter. There is one steam cotton and grist mill in Springfield, and two turpentine distilleries within 2½ miles; one in Livingston, the other in Tangipahoa Parish.

This examination was accomplished without extra expense, as I took yawlboat, men and provisions from the plant.

Very respectfully, your obedient servant,

C. D. ANDERSON,
Superintendent.

Capt. THOMAS TURTLE,
Corps of Engineers, U. S. A.

To this a supplementary report is added, which is as follows:

NEW ORLEANS, LA., *November* 5, 1884.

SIR: In answer to your communication asking what the obstructions are to a restoration of steam navigation on the Natalbany River, I have the honor to state that the obstacles mentioned in my report as extending from Springfield down a distance of about 3 miles have and will continue (unless removed) to obstruct the passage of

steamers, except the small tug-boats which sometimes avail themselves of high tide and run up to Springfield after saw-logs, but even they take considerable risk in doing so.

Previous to the war, steamers carrying several hundred bales of cotton ran to Springfield, but none have gone there since.

Very respectfully, your obedient servant,

C. D. ANDERSON,
Superintendent.

Capt. THOMAS TURTLE,
Corps of Engineers, U. S. A.

It is my opinion that the river is worthy of improvement up to the town of Springfield. No instrumental survey is required for present needs, and in view of the fact that the United States have a plant convenient and fitting to perform the work, the estimate of Major Stickney ($1,800) is concurred in.

Very respectfully, your obedient servant,

THOMAS TURTLE,
Captain of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

APPENDIX T.

IMPROVEMENT OF RIVERS AND HARBORS IN THE STATE OF TEXAS.

REPORT OF MAJOR S. M. MANSFIELD, CORPS OF ENGINEERS, BVT. LIEUT. COL., U. S. A., OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1885, *WITH OTHER DOCUMENTS RELATING TO THE WORKS.*

IMPROVEMENTS.

1. Entrance to Galveston Harbor, Texas.
2. Ship-channel in Galveston Bay, Texas.
3. Trinity River, Texas.
4. Buffalo Bayou, Texas.
5. Channel over the bar at mouth of Brazos River, Texas.
6. Pass Cavallo Inlet to Matagorda Bay, Texas.
7. Aransas Pass and Bay, up to Rockport and Corpus Christi, Tex.
8. Harbor at Brazos Santiago, Tex.
9. Protection of river bank at Fort Brown, Texas.

UNITED STATES ENGINEER OFFICE,
Galveston, Tex., July 25, 1885.

GENERAL: I have the honor to forward herewith my annual reports relating to the river and harbor improvements under my charge for the year ending June 30, 1885.

Very respectfully, your obedient servant,

S. M. MANSFIELD,
Major of Engineers,
Bvt. Lieut. Col., U. S. A.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

T 1.

IMPROVEMENT OF ENTRANCE TO GALVESTON HARBOR, TEXAS.

Estimate for north and south jetties, 1880	$1,825,813
Appropriated 1880–'85	825,000
Balance of estimate	1,000,813

ORIGINAL CONDITION OF THE LOCALITY.

The entrance forms connection between the Gulf of Mexico and Galveston Bay, and afforded a depth for navigation and commerce of about 12 feet over the outer bar, and about 11 feet over the inner bar, with an intricate channel of 12½ feet difficult of navigation. The outer bar, in semicircular form, stretched from Bolivar Peninsula on the east to

Galveston Island on the west, measuring 10 miles along its crest, and, as shown by Coast Survey Chart No. 105, had in 1867 but 11 feet at mean low tide in the best channel. The inner bar, opposite the head of Galveston Island, was a shoal obstructing Galveston Channel, and, according to chart No. 105 above mentioned, had a mean low depth over it of but 9½ feet. The material composing the bars, as well as the upper stratum of the shoals, beaches, &c., has all the characteristics of a quicksand, being of fine rounded sand, comminuted shell, and sand and shells mixed. The entrance being greatly exposed to the action of storms, waves and tidal currents made frequent changes in the shape of the bars and the channels across them, the progressive movement of the inlet and channel toward the southwest tending to injure the harbor and eventually to destroy it if permitted to continue.

PROJECT OF IMPROVEMENT.

To construct jetties and thereby confine the outflowing current for action upon a limited extent of bar, to obtain a channel of greater depth for navigation and commerce, the jetties to be in extent sufficient for the purpose, to consist of superposed layers of brush-mattresses and stone ballast. Estimated cost of jetties, $1,825,813, with a view to obtaining 25 feet in depth.

OPERATIONS PRIOR TO 1880.

From 1870 (first appropriation) to 1879 $653,000 were appropriated and applied to the improvement of the harbor. The result of the expenditure of $604,751.97 of the sum appropriated was the improvement of the inner bar—developing channel across so as to have in it a depth of 20 feet where before but 11 feet was found.

OPERATIONS FROM 1880 TO JUNE 30, 1884.

In June, 1880, a "trial section" of mattress work 90 feet by 60 feet by 2½ feet, with concrete ballast, was placed at the outer end of the Bolivar Gabionnade, on the north side of the channel.

South jetty.—Work on this jetty was begun in July, 1880, and continued, with a few intermissions due to exhaustion of funds, during 1880–'81–'82–'83, and '84, the last work having been done April 8, 1884. At this latter date the south jetty was a structure of brush-work and stone ballast, and extended from the pile breakwater at Fort Point out into the Gulf of Mexico, the total length of the jetty measured along its axis being 22,551 feet. The amount of material used in the work (including the 90-foot section on the north side) aggregated 294,267.60 cubic yards, viz, 212,635.57 yards of brush-work and 81,632.03 yards of concrete and stone ballast. The cost of this material in jetty, contingencies, superintendence, &c., included, was $967,770.84, or $3.287 per yard. Original estimate, $3.83. Proportion of ballast, one yard of stone to 3.6 yards of brush-work.

Sand fences (about 500 linear feet) were built in 1882–'83 at Fort Point to protect Galveston Channel from drifting sand; 12 cords of brush were used in the erection of these fences, the cost of which, together with the labor, &c., employed, has been included in the total sum above given.

All work done at this point was by hired labor and purchase of materials chiefly by contract and partly in open market, and with plant owned by the Government.

The money used included a special fund of $100,000 given by the city of Galveston, by an ordinance passed April 16, 1883. No appropriation for this harbor improvement has been made by Congress since that

of August 2, 1882; consequently no work of improvement has been attempted since April 8, 1884, when funds became practically exhausted.

RESULTING EFFECT OF THE WORK.

In the Annual Reports for 1882, 1883, and 1884, it has been shown that the improvements made had resulting good effect upon the bar-channels almost from the inception of the work.

The Coast Survey chart of 1867 shows the best channel across the inner bar to have but 9½ feet water. In 1875 we had 12½ feet. In 1880 we had 20 feet. In 1884 (last survey) we had 26 feet. All at mean low tide.

The outer bar with but 11 feet in 1867, as shown in above-mentioned chart, had in 1882 (survey of June) 11½ feet, and in 1883 (the whole year) 13 feet, and this improved channel has been held constant in depth and position till the present time, a period of two and one-half years.

The practical value of this improvement is well shown by the books of the Galveston Pilots' Association. On examination thereof I found that the records kept of the arrivals and departures of the steamers of the Mallory line (making from eight to sixteen crossings monthly) were the most reliable ones to give the depths of water on the bar, as they were piloted out and in drawing but from 2 to 3 inches less water than was on the bar at the time of crossing. The records of the draughts of other vessels crossing the bar could not be relied on, for the reason that when a ship arrived off the bar drawing, say, 13, 15, or more feet of water, and anchored by a pilot, she paid full pilotage for that draught before lightering to cross the bar; whereas the Mallory line of steamers paid pilotage only for what they were drawing at the time of crossing the bar, and record made accordingly. The annexed statement (Table 1) shows the greatest draught carried over the bar from 1874 to 1885 by the steamers of the Mallory line. The table shows that with one exception—the steamer City of San Antonia drawing 12½ feet—the greatest draught was 12 feet that crossed the bar in 1874. Capt. James McDonald, bar pilot, informed me that at one time during that year the ship Coldstream, drawing 11 feet 7 inches, and the bark Cremona, drawing 11 feet 3 inches, outward bound, were detained by low water for nearly three weeks before crossing the bar. The 12½ feet draught mentioned above was due to the effect of a heavy easterly gale banking the Gulf water on the bar. Under the same conditions the steamship Pryor crossed the bar on October 26, 1883, drawing 15 feet.

Up to September, 1875, the records show but 12-feet draught till after the cyclone of September 15, 16, and 17, 1875, when the main ship-channel closed and a new one opened; and the greatest draught carried in the new channel by the Mallory steamers up to December 31, 1881, was 13 feet. In 1882, 13 feet 10 inches. In 1883, 13 feet 11 inches was the greatest draught carried by these same steamers.

A large number of vessels drawing more than these steamers have crossed the bar. The following are the names of some of them:

Schooner Ada Kennedy, April 5, 1882, 14 feet 2 inches.
Bark N. T. Bell, September 28, 1882, 14 feet.
Steamship Cornucopia, December 12, 1882, 14 feet 8 inches.
Steamship Empress, October 9, 1882, 14 feet 10 inches.
Bark Concord, June 10, 1883, 14 feet 6 inches.
Steamship Prior, October 26, 1883, 15 feet.

The pilots inform me that previous to the inauguration of the Government work in Galveston Harbor they took advantage of every inch of water on the bar, and as mentioned above left only 2 to 3 inches under the keel; whereas at the present time they allow 4 to 6 inches for the Mallory steamers on account of their flat bottoms.

A glance at table No. 2, wherein is shown the difference of draught between 1874, 1883, and 1884, shows that the mean depth in 1874 was but 11 feet 8 inches, while in 1883 it was 13 feet 7 inches, or an increase in depth of 1 foot 11 inches.

TABLE No. 1.—*Showing the greatest draught in feet and inches of the Mallory Line and other steamers crossing Galveston Bar for each month from January, 1874, to June, 1885, as taken from the books of the Galveston Pilots' Association.*

Months.	1874.	1875.	1876.	1877.	1877.	1879.	1880.	1881.	1882.	1883.	1884.	1885.
	Ft. in.	*Ft. in.*	*Ft. in.*	*Ft. in.*	*Ft. in.*	*Ft. in.*	*Ft. in.*	*Ft. in.*	*Ft. in.*	*Ft. in.*	*Ft. in.*	*Ft. in.*
January:												
Mallory Line	12 6	11 6	13 0	12 0	12 6	12 0	12 7	12 7	13 0	13 3	13 0	13 1
Other steamers	.....	12 0	.....	.....	.....	12 3	.....	.....	.....	13 8	14 0	14 0
February:												
Mallory Line	11 9	12 0	12 6	12 0	11 9	11 6	12 6	12 9	12 9	13 7	14 2	14 2
Other steamers	12 3	12 3	12 7	.....	12 3	12 5	.....	....	13 3	.....	.....	.....
March:												
Mallory Line	11 6	12 0	12 3	12 0	12 0	12 6	12 6	12 9	12 11	13 11	13 10	14 0
Other steamers	12 3	.....	12 9	.....	12 6	12 9	.....	.....	13 8	.....	.....	.....
April:												
Mallory Line	11 6	11 9	12 3	11 3	12 3	12 0	12 5	12 8	13 1	13 4	13 8	14 4
Other steamers	12 6	12 0	12 6	12 3	12 4	12 4	.....	.. ...	14 2	13 10	14 0	.....
May:												
Mallory Line	11 6	11 8	11 9	12 0	12 6	12 0	12 4	12 5	13 3	13 7	13 5	14 0
Other steamers	12 0	12 0	12 6	.....	.....	12 6	12 7	13 0	14 0	14 0	14 0	.....
June:												
Mallory Line	11 9	12 0	12 0	12 6	12 0	12 6	12 7	12 9	13 10	13 6	13 4	13 9
Other steamers	12 0	.....	13 0	.....	.....	.....	.....	.....	.....	14 6	14 0	.....
July:												
Mallory Line	12 0	11 9	12 0	11 9	11 9	12 6	12 10	12 4	13 0	13 6	13 5	.....
Other steamers	12 2	.....	12 6	12 0	.....	12 7	.....	12 6	.....	.....	14 0	.....
August:												
Mallory Line	11 8	11 6	12 0	11 9	12 3	12 6	12 10	12 10	13 2	13 7	13 11	.....
Other steamers	12 0	12 0	....	12 6	.....	....	....	....	13 8	14 0	14 0	.....
September:												
Mallory Line	11 6	12 9	12 6	11 6	12 6	12 6	12 9	12 9	13 6	13 6	13 6	.....
Other steamers	12 5	.....	.....	.....	.....	12 7	.....	.....	14 0	14 0	14 4	.....
October:												
Mallory Line	12 0	12 9	12 7	12 6	12 9	12 6	12 9	13 0	13 8	14 0	14 0	.....
Other steamers	12 5	.....	.....	12 8	13 0	.....	12 11	.....	14 10	15 0	14 11	.....
November:												
Mallory Line	11 6	12 9	12 9	12 6	12 6	12 6	12 9	13 0	13 6	13 11	13 8	.....
Other steamers	12 0	.....	.....	13 0	13 0	.....	.....	13 3	14 4	14 7	14 3	.....
December:												
Mallory Line	11 0	12 6	12 7	12 3	12 9	12 8	13 0	13 0	13 6	13 9	13 4	.....
Other steamers	12 5	12 9	.....	.....	.....	.....	13 4	.....	14 8	14 3	13 9	.....

TABLE No. 2.—*Showing the differences of draught of the Mallory steamers crossing the bar between* 1874 *and* 1883 *and* 1884.

Months.	1874.	1883.	1884.	Difference.	
				1874–1883.	1874–1884.
	Ft. in.	*Ft. in.*	*Ft. in.*	*Ft. in.*	*Ft. in.*
January	12 6	13 3	13 0	0 9	0 6
February	11 9	13 7	14 2	1 10	2 5
March	11 6	13 11	13 10	2 5	2 4
April	11 6	13 4	13 8	1 10	2 2
May	11 6	13 7	13 5	2 1	1 11
June	11 9	13 6	13 4	1 9	1 7
July	12 0	13 6	13 5	1 6	1 5
August	11 8	13 7	13 11	1 11	2 3
September	11 6	13 6	13 6	2 0	2 0
October	12 0	14 0	14 0	2 0	2 0
November	11 6	13 11	13 8	2 5	2 2
December	11 0	13 9	13 4	2 9	2 4
	12)140 2	163 1		12)23 3	23 1
	11 8	13 7		1 11	1 11
		11 8			
		1 11			

Now, when it is considered that the channel is permanently established in position, rendering passage of the bar safe at all times, the full value of the improvement may be realized.

PROBABLE OPERATIONS OF THE YEAR ENDING JUNE 30, 1886.

No construction work can be attempted because of want of sufficient funds. The small amount ($1,662.88) in hand may be adequate for the proper care of the valuable Government property belonging to the work, to which purpose it will be applied until exhausted, or until Congress shall decide, at its next session, its policy in regard to this improvement.

During the fiscal year ending June 30, 1887, there could be profitably expended $750,000 in continuing work of improvement inaugurated.

The estimated amount required for the completion of improvements, in accordance with the approval and adopted project, is $1,000,813. The original estimate was conditioned upon continuous work under annual appropriations of $500,000, which conditions have not been observed. Therefore it may prove necessary to increase the estimate in the near future to cover deficiencies caused by insufficient funds in the past five years, and the total lack of funds for the past two years.

The work is located in the collection district of Galveston. The nearest light-houses are at Bolivar Point and Fort Point, at entrance to Galveston Bay.

Money statement.

July 1, 1884, amount available		$5,477 19
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$3,633 31	
July 1, 1885, outstanding liabilities	181 00	
		3,814 31
July 1, 1885, amount available		1,662 88
Amount (estimated) required for completion of existing project		1,000,813 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		750,00 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

Statement of tonnage at the port of Galveston, Tex., for the fiscal year ending June 30, 1885.

Nationality of vessels, &c.	Number.	Tonnage.
Foreign vessels:		
Entered	137	85,905
Cleared	122	76,473
American vessels:		
Entered (foreign)	23	11,206
Cleared (foreign)	24	12,964
Coasting trade:		
Entered	310	301,873
Cleared	305	300,328
Aggregating	921	788,749

CUSTOM-HOUSE, GALVESTON, TEX.,
Collector's Office, July 8, 1885.

T 2.

IMPROVEMENT OF SHIP-CHANNEL IN GALVESTON BAY, TEXAS.

Original estimate (for channel 100 feet wide and 12 feet deep), 1877..... $446,326 42
Appropriated, 1872 to *1885..... 446,500 00

ORIGINAL CONDITION OF THE LOCALITY.

In 1871 the natural channel through the bay had a depth of not more than 7 feet at the shoalest places, the average depth 8½ feet, with bottom of soft mud, sand, and shells.

PROJECT OF IMPROVEMENT.

Estimate of 1877 (modifying that of 1871) was $446,326.42, with which sum it was proposed to deepen and widen the channel from the head of Bolivar Channel to the cut through Morgan's Point, to afford a channel 12 feet deep at mean low tide, with a width at bottom of 100 feet.

OPERATIONS PRIOR TO JUNE 30, 1884.

During 1872, '73, '74, '75, and '76, in 1879 and '80, and in 1882 and '83, by contract and by Government machinery, dredging was carried on through Red Fish Bar and in the lower and upper bays, the work resulting in a navigable channel of 8.9 feet at mean low tide from Bolivar Channel to Morgan's Cut. The amount of money expended in this work was $286,629.50.

No work was done during the fiscal year 1883–'84, owing to the reserving of the available funds for Congressional action, "because of the probability that the improvement demanded could not be made a permanent one at any reasonable cost, that the cost of maintenance would be relatively excessive, that the necessity for the channel was far less than formerly, and that it was not called for in the interests of commerce for the present."

PROGRESS MADE DURING THE YEAR ENDING JUNE 30, 1885.

It was provided in the act of July 5, 1884, that the money in hand should not be expended until the Secretary of War be satisfied that the Buffalo Bayou Ship-Channel Company has relinquished or abandoned to the United States, forever, all the franchises and any and all right to collect or impose tolls or charges from any part of said ship-channel or Buffalo Bayou.

The views suggested in letter August 7, 1884, office of the Chief of Engineers, viz, to call upon the stockholders of the Buffalo Bayou Ship-Channel Company for their consent to the surrender and transfer of their charter, &c., to the United States, were complied with by letter from this office August 13. On the 14th of October Mr. Cave, president of the company, in reply, stated that the matter was having full consideration. Since then nothing has been heard of the matter, and the subject remains in abeyance in so far as this office is concerned.

PROBABLE OPERATIONS OF THE YEAR ENDING JUNE 30, 1886.

The operations of the year will altogether depend upon the action of the stockholders of the Buffalo Bayou Ship-Channel Company. If agreeable to the requirements of the Department, proposals for dredging and

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*Last appropriation, 1882.

staking out channel in the bay will be invited and contract be awarded in the usual way, the work to be in accordance with the approved plan. If the stockholders should refuse to surrender their charter, &c., or to fully comply with the requirements of the Department, or delay action through the greater portion of the year, then nothing will be done.

The work is in the collection district of Galveston. The light-houses on or near the line of work are at Bolivar Point, at Fort Point, at Half-Moon Shoal, at Red Fish Bar.

The local commerce between Houston and Galveston is the only interest to be subserved by this improvement, and which for the past year is given by the Houston Direct Navigation Company as 61,050 tons.

Money statement.

July 1, 1884, amount available	$159,870 50
July 1, 1885, amount available	159,870 50

T 3.

IMPROVEMENT OF TRINITY RIVER, TEXAS.

Estimate of 1880, dredging bar and removing snags above and below Liberty and dredging bar at the mouth of Middle Pass	$36,541
Appropriated 1880–'85	*22,000
Balance of estimate	14,541

ORIGINAL CONDITION OF THE LOCALITY.

In 1879 the river above Liberty, the head of tide-water, 41 miles from its mouth, was a succession of rock and gravel shoals, with deep pools between, very tortuous, and obstructed by water-logged snags, which were not carried off during high stages of river. Below Liberty the character of the river was entirely different. Between Liberty and Moss Bluff it varied in width from 200 to 275 feet, and in depth from 5 to 30 feet, with the exception of a bar, with 2 feet water over it. 4½ miles below Liberty. From Moss Bluff to the mouth of the river it opened out to 500 feet in width, and a depth of from 10 to 45 feet, free from any obstruction. It flowed into Galveston Bay through four principal channels and a number of small bayous. About 4½ feet could be carried across the bar at the mouth of the river, in the best natural channel.

PROJECT OF IMPROVEMENT.

The estimate of 1871–'73 was $46,000, for pile-breakwater, dredging, removing snags, &c. Estimate of 1880, $36,541, was for dredging, snagging, &c., to secure a channel for navigation of 5 feet draught from the mouth up to Liberty.

OPERATIONS FROM 1880 TO JUNE 30, 1884.

(1) *Contracts with Seth N. Kimball, of June* 10, *and November* 14, 1879.—Forty-seven thousand three hundred cubic yards of materials were removed from the entrance-bar, leaving a dredged channel of not less than

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* Appropriated 1878–'79, $12,500, making a total of $34,500 appropriated 1878–'85.

5½ feet depth, averaging 110 feet width, and in length across the bar 4,800 feet. Work done in June and July, 1880.

(2) *Contract with G. L. Long, of July* 25, 1881.—Two thousand nine hundred cubic yards of sand were removed in making a cut 85 feet wide and 7 feet deep through a bar located about 4 miles below Liberty; also, thirty-three snags and twenty-five overhanging trees were removed and the river cleared of other obstructions for that portion between its mouth and Liberty. Work done in April, 1882.

The amount expended upon these improvements, including superintendence and contingencies of office, was $20,695.79, and resulted in temporarily opening the river to navigation so as to admit vessels of 5 feet draught.

PROGRESS MADE DURING THE YEAR ENDING JUNE 30, 1885.

The sum of $13,804.21 was available July 1, 1884, being the balance of appropriations of 1881 and 1882. Project for its expenditure was forwarded August 12, proposing to build a sheet-pile revetment across the bar at the mouth of Middle Pass and to dredge a channel alongside of it to a depth of 6 feet, throwing the material behind the revetment and to the west side, as the drift was toward the east.

The following proposals were received in response to advertisement of August 23, 1884, and opened September 15, 1884:

No.	Names of bidders.	Sheet pile revetment, 2,400 linear feet, per foot.	Dredging 15,000 cubic yards, per yard.	Aggregate.
			Cents.	
1	John J. Atkinson	$3 00	15	$9,450
2	W. A. Junker	3 50	18	11,100
3	Rittenhouse Moore	3 25	19	10,650

Contract was entered into with John J. Atkinson October 15, 1884. Work to commence November 1, 1884, and to be completed June 30, 1885.

In November the contractor gathered his plant, &c., at the mouth of Middle Pass, and during the month drove sixteen piles in back row of the revetment.

Unusually stormy weather in December prevented rapid work during that month. In January, and to include the first half of February, Mr. Atkinson was forced to suspend operations because of prevalent rough weather and high water. During the time of this forced suspension sundry needed repairs were made to the plant.

The revetment, as completed in April, was built in accordance with the conditions and requirements of the contract. It measures a total length of 2,775 feet, its top in a plane 4½ feet above the surface of mean low tide. The dredging done amounted to 23,275 cubic yards, the material being satisfactorily disposed of behind the revetment and in other suitable places.

The amount paid contractor (contract closed May 30, 1885) for this work was: For revetment, $8,325; for dredging, $3,490.79. The entire work was satisfactorily performed.

The results obtained are such as exist in a channel of entrance to the river by Middle Pass of over 6 feet depth, and which will remain perfect for at least the next fall and winter season.

PROBABLE OPERATIONS OF THE YEAR ENDING JUNE 30, 1886.

It is thought that recent work of improvement will satisfy every demand of commerce and navigation during the year. For this reason, and also for want of funds, no work can or will be undertaken in the year 1885–'86.

During the fiscal year ending June 30, 1887, there could be profitably expended $14,541, the balance of the estimate of 1880, in continuing work of improvement originally intended.

There exists no basis for estimating the length of time the cuts made through the bar at the mouth and the bar at Liberty will remain open for navigation, or of the cost of maintaining the river from its mouth to Liberty in a navigable condition.

The work is located in the collection district of Galveston. Nearest light-house, Red Fish Bar, Galveston Bay.

Money statement.

July 1, 1884, amount available	$13,804 21
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	13,297 71
July 1, 1885, amount available	506 50
Amount (estimated) required for completion of existing project	14,541 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	14,541 00
Submitted in compliance with requirements of section 2 of river and harbor act of 1866 and 1867.	

T 4.

IMPROVEMENT OF BUFFALO BAYOU, TEXAS.

Estimate of 1880, for channel 100 feet wide and 12 feet deep between Simm's and White Oak Bayou	$385,299 75
Appropriated, 1881–'85	100,000 00
Balance of estimate	285,299 75

ORIGINAL CONDITION OF LOCALITY.

The bayou, a tide-water stream, emptying into the San Jacinto River at Lynchburg, about 25 miles from Houston, was, in 1880, only navigable for vessels of 6 feet draught below Houston. For 3 or 4 miles below White Oak Bayou the banks ranged from 20 to 45 feet in height, and at points were very bluff, with a tendency to caving during high water. The narrowness and tortuousness of the bayou for this distance, with its sharp bends, were the most serious obstructions to its navigation.

PROJECT OF IMPROVEMENT.

To increase the navigable capacity of the stream, it was proposed to do dredging, snagging, and remove overhanging trees, &c., the estimate for a channel 100 feet wide and 12 feet deep, between Houston and Clinton, embracing the following: 1,313,130 cubic yards of dredging, 7,900 linear feet of sheet-piling, and 11.2 miles overhanging trees. Twenty-five thousand dollars was appropriated March 3, 1881, and made applicable "to secure a channel of 100 feet."

OPERATIONS FROM 1882 TO JUNE 30, 1884.

(1) *Contract with G. L. Long, September* 1, 1883: Overhanging trees removed for a distance of 11.2 miles of bank; 98,910 cubic yards of material removed from bed of the stream.

(2) *Contract with John J. Atkinson, November* 11, 1882: Overhanging trees, underbrush, &c., were removed from 1,247,810 square feet of bank; 153,708 cubic yards of material and 1,350 logs and stumps were removed from shoal and narrow places on the bayou.

The amount expended in carrying on the work under these contracts was $74,413.61, which resulted in developing the channel along the bayou to quite an extent.

Selected points received main attention with a view to advantageous expenditure of the limited appropriations.

PROGRESS MADE DURING THE YEAR ENDING JUNE 30, 1885.

Twenty-five thousand dollars were appropriated by act of July 5, 1884, for continuing improvement.

Project for the expenditure of this amount was forwarded July 21, and proposed continuing work according to the approved plan, viz, by dredging, snagging, &c., to the limit of available funds, at points where thought most necessary for judicious expenditure.

The following proposals were received in response to advertisement of August 2, 1884, and opened August 21, 1884:

No.	Names of bidders.	Dredging 50,000 cubic yards per yard.	Removing 1,000 stumps and logs, per stump.	Aggregate.
		Cents.		
1	John J. Atkinson	24	$3 00	$15,000
2	Rittenhouse Moore	23	2 70	14,200
3	W. A. Junker	26	3 00	16,000

Contract was entered into with Rittenhouse Moore September 12, 1884, work to commence October 1 (afterward extended to November 1), 1884, and to be completed June 30, 1885.

A beginning of work under his contract was made by Mr. Moore on the 24th of November, at which date he had one dredge and one derrick in position for work at the junction of White Oak and Buffalo bayous.

The work was very much impeded in December and January by high water, the stream for some time rising above the bulkhead upon which the derrick stood, preventing all dredging for about three weeks. In April one dredge and derrick was detached for service at the mouth of the Trinity River, which tended to a still slower progress of the bayou work.

By June 30 (contract of September 12, 1884, with Mr. Rittenhouse Moore, not completed) the following had been accomplished: 78,600 cubic yards of material excavated and removed from shoal and narrow places in the bayou, and 277 stumps, logs, &c., extracted and removed from the bed of the stream. The points selected for work were those upon which the limited amount of available funds could be most advantageously applied, and covered the bayou from Houston to a point

6 miles below, where the work stopped in August, 1883. The contractor received for this work $18,825.90; and the work was most satisfactorily done.

Authority has been given to the contractor, by letter of June 24, 1885, Office of the Chief of Engineers, to continue work so as to complete the contract within sixty days after June 30, to include August 31, 1885.

The results so far of the expenditure during the year are in the nature of a slow progression toward a definite object, which looks to ameliorating the present condition of the channel for navigation while approaching the future condition of a complete and permanent improvement of the full-sized channel-way required. The annual grants being so small, in proportion to the extent of work, demand this method of procedure, which is probably not the most economical method of making the desired improvement.

PROBABLE OPERATIONS OF THE YEAR ENDING JUNE 30, 1886.

Congress having failed to supply funds for expenditure upon this work during the fiscal year 1885–'86, and the present available amount being inadequate for anything more than contingencies of office, nothing in the way of formulating a project for the year's work of improvement can here be mentioned.

During the fiscal year ending June 30, 1887, there could be profitably expended $100,000 (the annual estimate) in continuing work of improvement by dredging, snagging, &c., in conformity with original project.

It is in the collection district of Galveston, and the nearest light-houses are those in Galveston Bay and at the entrance to Galveston Harbor, Texas.

Money statement.

July 1, 1884, amount available		$586 39
Amount appropriated by act approved July 5, 1884		25,000 00
		25,586 39
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$19,524 28	
July 1, 1885, outstanding liabilities	1,584 24	
		21,108 52
July 1, 1885, amount available		4,477 87
Amount (estimated) required for completion of existing project		285,299 75
Amount that can be profitably expended in fiscal year ending June 30, 1887		100,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

STATEMENT OF FREIGHT CARRIED BY HOUSTON DIRECT NAVIGATION COMPANY FOR THE YEAR ENDING MAY 31, 1885.

	Pounds.
Cotton (136,044 bales)	68,022,000
Merchandise	1,430,453
Railroad iron	13,419,030
Lumber	1,064,000
Salt	5,581,600
Oil	1,157,174
Slate	940,800
Coal	9,786,560
Gas-pipe	1,805,275
Cotton-seed cake	18,894,060
Total	122,100,952

L. MEGGET, *Secretary*,
Houston, Texas, July 15, 1885.

T 5.

IMPROVEMENT OF MOUTH OF BRAZOS RIVER, TEXAS.

Estimate for jetties, 1880	$522,890 44
Appropriated, 1880–'85	140,000 00
Balance of estimate	382,890 44

ORIGINAL CONDITION OF THE LOCALITY.

The river debouches into the Gulf of Mexico through a single natural outlet, and preserves a nearly uniform width and depth from the coast for several miles up-stream, the width averaging from 500 to 600 feet, the depth from 15 to 18 feet. The bed of the river is soft mud; the banks, except at a few points, being above overflow. A bar had formed at the mouth of sand drifted along the shore and driven in by the sea. The crest of the bar was about three-eighths of a mile from the shore-line, and the channel across afforded a variable depth of water for navigation of, at times, not over 8 feet (in October, 1874, only 2½ to 3 feet), being subjected to changes, due to winds, tide, and stages of water in river.

PROJECT FOR IMPROVEMENT OF THE BAR CHANNEL.

The project was originally adopted in 1880, and looked to the amelioration of the channel over the bar by the use of jetties; the positions of the jetties to be determined by the local engineer upon the general principle that they should be parallel, or nearly so, that they should terminate in 18 or 20 feet water, and that their position be so chosen as to fix the channel in its natural direction. Approximate length of north jetty, 3,600 feet; of south jetty, 4,350 feet. Estimated cost, $522,890.44.

OPERATIONS FROM 1880 TO JUNE 30, 1884.

North jetty.—This work, having a good shore-bearing, was constructed with a total length of 2,433 feet, the inner portion being practically complete in height for a distance of 1,493 feet outward from the shore-line of 1882.

South jetty.—Owing to the impossibility of laying mattresses advantageously in a seaward direction by reason of the rapid shoaling of the water, the foundation course of this jetty was extended only 700 feet, the work commencing at a point 2,000 feet distant from the shore, running on a curve to the eastward, leaving the distance between the jetties 750 feet, both works being parallel.

Amount expended in these operations, $129,196.67. The jetties were constructed of brush-mattresses and concrete ballast, the shore work on north side of the channel receiving a covering of beach sand.

On June 30, 1884, the improvement was such as to afford a very constant depth of 8 feet throughout the season for crossing the bar at the mouth of the river.

PROGRESS MADE DURING THE YEAR ENDING JUNE 30, 1885.

A project for the expenditure of the $10,000 appropriated by act of July 5, 1884, was forwarded July 21, 1884, with recommendation that the funds be made available for use in filling up low places in work on the north side of channel and for extra ballast to preserve and protect the work in place in the jetty wherever necessary.

The following proposals were received in response to advertisement of August 2, 1884, and opened August 21, 1884:

No.	Names of bidders.	Brush, 1,600 cubic yards.	Ballast, 700 tons.	Aggregate.
		Per yard.	*Per ton.*	
1	Frederick A. Brock	$2 25	$4 25	$6,575
2	R. Kanters & Sons	2 58	5 50	7,978
3	A. M. Shannon & Co	3 00	5 00	8,300
4	Rittenhouse Moore	2 50	4 00	6,800

Contract was entered into with Frederick A. Brock September 8, 1884. Work to commence October 1, 1884, and to be completed June 30, 1885.

Mr. Brock began work on September 21, and completed his contract December 17.

During September and October the work was delayed by stormy weather, the heavy seas and high water which prevailed causing the inner portion of the jetty to be almost entirely covered with drift—logs, &c.—necessitating the removal of the same prior to the placing of any mattress work, thereby not only impeding the work of construction, but also adding, in a great measure, to the embarrassment of the contractor in pushing his work.

The whole work of this contract was satisfactorily performed. The total amount of material put into the work was 3,556.44 cubic yards of brush-mattresses and concrete ballast, the components being 2,694.07 yards of brush and 862.37 yards of concrete. All work was applied to the north jetty, and covered the extension of the upper courses from shore-line gulfward, raising the work above the plane of high water for a distance of 578.6 feet. The contractor received for this work $9,334.03, or $2.624 per cubic yard. Including superintendence and contingencies, the cost to the United States was $2.903 per cubic yard.

For the reason that the amount available for expenditure in the year was limited to so small a sum extensive construction was impossible, and the work, in consequence, was confined to a mere matter of repair; and the result of the expenditure in the manner described has, it is thought, simply held the improvement in about the condition reported at the close of 1884.

An examination of the old work of the north jetty, made on the 6th of December, revealed the fact that its line was unbroken, with an average depth of 4 feet of water over it at mean low tide.

PROBABLE OPERATIONS OF THE YEAR ENDING JUNE 30, 1886.

For the reason that Congress appropriated no funds for expenditure in the year, and because of the totally inadequate balance on hand, no work can be projected for in continuing improvement at this point.

During the fiscal year ending June 30, 1887, there could be profitably expended $100,000 (the annual estimate) in continuing jetty construction in accordance with the adopted plan.

This work may not be susceptible of entire and permanent completion. Estimates will vary accordingly.

It is located in the collection district of Galveston, and the nearest light-house is at the entrance to Galveston Harbor.

Money statement.

July 1, 1884, amount available	$803 33
Amount appropriated by act approved July 5, 1884	10,000 00
	10,803 33
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	10,457 80
July 1, 1885, amount available	345 53
Amount (estimated) required for completion of existing project	382,890 44
Amount that can be profitably expended in fiscal year ending June 30, 1887	100,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

Coasting trade at Velasco: Number entered and cleared, 84; tonnage, 1,547.

CUSTOM-HOUSE,
Galveston, Tex., July 8, 1885.

T 6.

IMPROVEMENT OF PASS CAVALLO INLET TO MATAGORDA BAY, TEXAS.

Estimate, south jetty and groins for shore protection, 1879	$1,039,280
Appropriated, 1876–'85	290,000
Balance of estimate	749,280

ORIGINAL CONDITION OF THE LOCALITY.

The Pass forms the connection between the Gulf of Mexico and a large inland basin (approximate area, 520 square miles), comprising Matagorda Bay, Espiritu Santo Bay, San Antonio Bay, and numerous small bays further inland and connecting with these. Its history, like that of other entrances on this coast, showed a steady deterioration as a harbor and a constant shifting of the channel to the south and west. The bar, composed of loose shifting sand and fully exposed to the action of storms, permitted entrance of vessels drawing not more than 8 feet, the ever-varying channel having a depth of from 7 to 9 feet.

PROJECT OF IMPROVEMENT.

To extend one jetty from the head of Matagorda Island in a southeasterly direction, and construct groins for shore protection whenever necessary; jetty and groins to be of brush-mattress work ballasted with concrete and stone. Object of the work, to obtain a 12-foot channel across the bar. Estimated cost, $1,039,280.

OPERATIONS FROM 1880 TO JUNE 30, 1884.

South jetty.—By the end of June, 1884, this work had in place in its foundation-course and superposed courses 39,673.15 cubic yards of brush-mattresses and concrete and stone ballast, giving an incomplete work a total approximate length of 5,253 feet, and in position, as outlined in approved project. The amount expended to June 30, 1884, was $234,255.09,

PASS CAVALLO
TEXAS

FROM SURVEY MADE UNDER THE DIRECTION OF

MAJOR S. M. MANSFIELD U.S. ENG'RS

BY

H. C. RIPLEY U. S. ASST ENG'R

ASSISTED BY

J. M. PICTON

FROM APRIL 6th. TO 29th.

1885

SCALE OF FEET

1000 0 1000 2000 3000 4000 5000

L. S.

H. L.

TRUE MERIDIAN

WRECK METIOR

R. I.

I.

LT. HO.

Note

Soundings are expressed in feet and show the depth at mean low water of time of survey. A subsequent determination of the plane of mean low tide by comparison with Galveston, in June, shows the assumed plane to be too high by 7/10 of a foot. Hence all soundings on this chart must be reduced by that amount to show the depth at Mean Low Tide.

U. S. Engineer Office
Galveston, Tex.
To accompany my Annual
report June 30th 1885.
M. Mansfield
Maj. of Engrs
Bvt. Brig. Gen. U.S.A.

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and resulted in an improvement in depth of channel across the bar and in giving the channel permanency in position in a direction more suitable for navigation.

PROGRESS MADE DURING THE YEAR ENDING JUNE 30, 1885.

Project for the expenditure of the money ($50,000) appropriated by act of July 5, 1884, was forwarded July 21, proposing to continue work on south jetty, in accordance with the approved plan, by adding to the work certain courses of brush mattresses and stone ballast to extend and build up the jetty, thereby aiding to a certain limit the improvement, which looked to obtaining a 12 foot channel across the bar.

The following proposals were received in response to advertisement of August 2, and opened August 21, 1884:

No.	Names of bidders.	Brush, 9,000 cubic yards, per yard.	Ballast, 2,000 tons per ton.	Aggregate.
1	James E. Slaughter	$3 24	$5 74	$40,640
2	R. Kanters & Sons	3 70	5 75	44,800
3	A. M. Shannon & Co	2 90	5 15	36,400
4	Rittenhouse Moore	2 85	5 95	37,550

Contract was entered into with A. M. Shannon & Co. September 6, 1884. Work to commence October 1, 1884, and to be completed June 30, 1885.

For sufficient reasons the contractors were permitted to defer work of jetty construction until April, 1885; conditioned that collection of material, &c., would be carried on during the winter, so that when the work commenced it might be pushed to completion within the time specified, viz, June 30.

By the close of April the contractors had gathered a quantity of material—500 tons of stone and 600 cords of brush—wherewith to begin mattress-making and jetty-building; and at the end of the fiscal year (contract not completed) they had accomplished the placing of 7,157.89 cubic yards of mattress-work and 1,861.5 tons of stone ballast in the jetty, whereby the structure was raised to a higher plane where considered most desirable for economical expenditure of the limited funds available for the work. The amount expended (paid or still due contractors) was $30,344.60, or at the rate of $3.27 per cubic yard.

This contract looks to giving the south jetty larger proportions, with a view to throwing a more concentrated outward current upon a limited portion of the bar to develop a deeper channel thereon; and, incidentally, by further work when funds are appropriated, slowly approach the consummation of the desired improvement.

An examination and survey was made April 6–29; map of same being submitted herewith.

PROBABLE OPERATIONS OF THE YEAR ENDING JUNE 30, 1886.

Authority to extend the time of completing the contract of A. M. Shannon & Co. to September 30, 1885, was granted by letter of June 16, office of the Chief of Engineers.

No appropriation being available for expenditure in the fiscal year 1885–'86, a project of operations cannot be made at this time. Therefore, after the work embraced in A. M. Shannon & Co.'s contract shall

have been completed, the funds will be exhausted and further operations upon this improvement be arrested.

During the fiscal year ending June 30, 1887, there could be profitably expended $200,000 (the annual estimate) in continuing construction of south jetty in accordance with the approved plan.

The work is located in the collection district of Indianola, Tex., and near Matagorda light-house.

Money statement.

July 1, 1884, amount available		$5,579 01
Amount appropriated by act approved July 5, 1884		50,000 00
		55,579 01
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$9,063 05	
July 1, 1885, outstanding liabilities	24,332 91	
		33,395 96
July 1, 1885, amount available		22,183 05
Amount (estimated) required for completion of existing project		749,280 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		200,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

CUSTOM-HOUSE, INDIANOLA, TEX.,
Collector's Office, July 14, 1885.

DEAR SIR: In reply to your letter of 6th instant, I have respectfully to inform you that during the year ending June 30, 1885, there were the following number of vessels entered and cleared at this office, viz:

Entered from domestic ports	62
Cleared for domestic ports	4
Foreign entrances and clearances	None.

The above comprises but a small portion of the number of vessels which visited this port during the above period, as by the laws of the United States most of the coasting vessels were not required to enter at the custom-house nor clear therefrom. I am unable to give anything approximating the amount of goods, &c., shipped through the port, as it was all carried coastwise and but little of same reported to this office.

Very respectfully,

FRANCIS A. VAUGHAN,
Collector.

To S. M. MANSFIELD,
Major of Engineers, U. S. A.

T 7.

IMPROVEMENT OF ARANSAS PASS AND BAY UP TO ROCKPORT AND CORPUS CHRISTI, TEXAS.

Estimate for jetties, groins, shore-protection, &c., 1879	$759,185 00
Estimate for dredging, &c., in the bay, 1879	441,537 75
	1,200,722 75
Appropriated 1879–'85	380,000 00
Balance of estimate	820,722 75

ORIGINAL CONDITION OF LOCALITY.

The pass forms connection between the Gulf of Mexico and Aransas and Corpus Christi bays, and its history, like other entrances on this coast, shows a constant movement of its channel to the south with pro-

gressive shoaling therein and enlargement of the Gulf Bar, which, composed of fine shifting sand, &c., crowns the entrance at a distance of about three-fourths of a mile from the shore. Across the bar during the year preceding the commencement of this work of improvement the best water available for navigation was 5 to 5½ feet, and this in a channel constantly changing its position. In the interior channels the depth afforded for navigation up to Rockport and Corpus Christi was about 8 feet.

PROJECT OF IMPROVEMENT.

To extend jetties from the south end of Saint Joseph's Island and the north end of Mustang Island, contracting the width of water-way out to a sufficient distance to afford a draught of 12 feet at mean low water over the bar, and to construct groins, in conjunction with a beach-flooring of mattresses, for the protection of the head of Mustang Island up to and beyond Turtle Cove, and to plant trees upon Saint Joseph's Island for its protection against abrasion by winds. Estimated cost of jetties, groins, &c., $759,185.

In the matter of improving the interior channels for navigation from Aransas Pass up to Rockport and Corpus Christi, the discussion of the problem was left to wait upon the protection of the islands from abrasion and upon the success of the attempt to increase the depth over the bar to 12 feet. (Estimated cost, Major Howell, 1879, $441,537.75.)

OPERATIONS FROM 1880 TO JUNE 30, 1884.

(1) *Protecting head of Mustang Island up to and beyond Turtle Cove.*—This was effected by the construction of seven groin-jetties, built on the west side of the pass, with a breakwater and revetment along the channel-face of Mustang Island.

(2) *Protecting channel from drifting sand.*—This by means of a number of sand-fences built on Saint Joseph's and Mustang islands.

(3) *Sustaining outward current for effective work in bar-channel.*—This was being accomplished by the construction of a jetty, projected 3,900 feet in length, on the south side of the channel, running from the shore-line on Mustang Island in a direction north 87 degrees east, curving to the northeast at its outer end.

The groins, breakwater revetment, and jetty were constructed of brush-mattresses and stone ballast, and the amount expended to June 30, 1884, was (including $9,938.93 subscribed by private parties) $288,850.31. The resulting effect of this was the securing of the head of Mustang Island, as required, and the developing of a fine straight channel across the bar of not less than 10½ feet at mean low tide, and quite constant in position.

PROGRESS MADE DURING THE YEAR ENDING JUNE 30, 1885.

Project for the expenditure of the appropriation of $100,000 made by act of July 5, 1884, was forwarded July 5, and proposed the raising of the south jetty and extension of the work seaward. For the reason that the project had in view the raising of the inner portion by a pile structure filled with brush and ballasted, and because it was desirable to utilize the most favorable season of the year for the purpose, it was recommended to do *that* work by hired labor and purchase of material in open market; all mattress-work, used either in raising the jetty to a higher plane or in extending it Gulfward, to be done by contract. It

was expected by this work to obtain a fixed channel of greater depth, so that the work of opening up the interior channels might be commenced and the channel of improved depth be had from the Gulf to Rockport and Corpus Christi.

The following proposals were received in response to advertisement of July 25, 1884, and opened August 9, 1884:

No.	Names of bidders	Brush, 17,000 cubic yards (per yard).	Stone, 4,800 tons (per ton).	Aggregate.
1	Hoag & Petitdidier	$5 30	$4 70	$112,660
2	R. Kanters & Sons	4 25	6 00	101,050
3	Rittenhouse Moore	2 60	5 50	70,600
4	A. M. Shannon & Co	2 70	4 40	67,020
5	Isaac Heffron	2 60	5 30	69,640

Contract was entered into with A. M. Shannon & Co., August 27, 1884, work to commence September 1, 1884, and to be completed June 30, 1885.

The work of building superstructure by hired labor began July 31, and the contractors laid their first mattresses (six, each 98′ by 30′ by 2′.7) in the foundation-course, extending the jetty seaward, on the 21st of September.

From the beginning in September and until near the completion of the work in April operations were carried on under difficulties, mainly owing to the extreme bad weather experienced during the time. Heavy seas, high tides and rapid currents, and unusually stormy weather prevailed in September, October, November, and December, and from January to March, inclusive, it was generally unfavorable for rapid progress.

The contract work was completed March 17, the amount of material used in the work covering 23,016.69 cubic yards of brush-work and 4,626.15 tons of stone ballast, equal to 28,242.24 cubic yards of jetty, the cost of which (paid contractors) was $82,500.06, or $2.92 per yard. The contract was satisfactorily performed.

The auxiliary work by hired labor and purchase of material in open market was virtually finished in the first week in April. It consisted in building superstructure upon finished contract work, and included the compacting of the work by a pile system, and the securing of the brush-work by a carefully placed stone topping.

The object of this work (contract and auxiliary hired labor, &c.) was the extending and raising of the south jetty and the securing of a good shore-connection, with a view to obtaining the improvement desired, the result of the work being shown in the accompanying chart of survey made in May and June.

PROBABLE OPERATIONS OF THE YEAR ENDING JUNE 30, 1886.

The balance of the funds in hand, $6,913.11, will be applied to the preservation of the present work by supplying deficiencies as they may occur by action of the sea, and making needed repairs, and contingencies of office. After the expenditure of the amount reserved for the work above specified operations must cease, no appropriation having been made for this work during the fiscal year 1885–'86.

During the fiscal year ending June 30, 1887, there could be profitably expended $500,000 in constructing works at the Pass and improving the interior channels.

The work is located in the collection district of Corpus Christi, and the nearest light-house is at Aransas Pass.

Money statement.

July 1, 1884, amount available	$1,088 62
Amount appropriated by act approved July 5, 1884	100,000 00
	101,088 62
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	94,175 51
July 1, 1885, amount available	6,913 11
Amount (estimated) required for completion of existing project	820,722 75
Amount that can be profitably expended in fiscal year ending June 30, 1887	500,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS, ROCKPORT, FULTON, AND SAINT MARY'S, FOR FISCAL YEAR ENDING JUNE 30, 1885.

[Furnished by Mr. Samuel J. Seymour, secretary and treasurer Coleman-Fulton Pasture Company, Rockport, Tex.]

Outward shipment:		
Cattle	head	4,490
Horses	head	100
Merchandise	barrels	3,455
Cotton	bales	50
Hides	number	400
Inward shipment:		
Merchandise	barrels	22,800
Lumber	feet	619,980
Shingles	number	533,000

LETTER OF COLLECTOR OF CUSTOMS AT CORPUS CHRISTI, TEXAS.

CUSTOM-HOUSE, CORPUS CHRISTI, TEX.,
Collector's Office, July 25, 1885.

SIR: In compliance with your request I have the honor to submit the following summary statement of the transactions of this district for the year ending June 30, 1885. Here allow me to say that the following statement does not embrace tonnage of vessels nor the value of commodities transported therein which are not by law required to enter and clear from this port.

Entrances and clearances.	Number.	Tonnage.
Vessels entered from foreign ports	4	497
Vessels cleared to foreign ports	4	497
Vessels entered from domestic ports	52	32,342
Vessels cleared to domestic ports	50	32,186

Value of exports to foreign countries	$335,469
Value of imports from foreign countries	1,512,666

I am, very respectfully,

LOVELL H. JEROME,
Collector.

To Colonel MANSFIELD, U. S. A.

T 8.

IMPROVEMENT OF HARBOR AT BRAZOS SANTIAGO, TEXAS.

Estimate for jetties and interior dam, 1881	$678,084 50
Appropriated 1880–'85	*185,000 00
Balance of estimate	493,084 50

ORIGINAL CONDITION OF THE LOCALITY.

The Pass which forms the connection between the Laguna Madre and the Gulf of Mexico separates Brazos Island from Padre Island, and the harbor within was obstructed directly across the mouth of the Pass by a bar in the usual curved form, situated so as to be entirely exposed to heavy storms, and being of a quicksand formation easily acted upon by tidal currents, the best water (in an ever-shifting channel) across it was about 7 feet. In the harbor the greatest depth was 27 feet.

PROJECT OF IMPRCVEMENT.

To extend two parallel jetties entirely across the bar to the 12-foot curve, the width between the jetties to be about the same as the narrowest part of the Pass, viz, 1,500 feet; the south jetty (Brazos Island Jetty) to be 3,630 feet long, and the north jetty (Padre Island Jetty) to be 2,940 feet; the direction of the jetties to be in prolongation of the Pass; the estimated cost of the south jetty about $190,000; estimated cost of the north jetty about $130,000. In addition, to construct a dam from Point Isabel to Brazos Island, to increase the depth of water on the bar and in the channel to Point Isabel, by preventing the flow toward Boca Chico; the estimated cost about $328,000.

Approval was given to so much of the project as covered the construction of the south jetty, leaving the question of the north jetty and of the inner dam to the future.

OPERATIONS FROM 1882 TO JUNE 30, 1884.

South jetty.—The work, extending from Brazos Island, with a total (approximate) length of 3,500 feet, was built of superposed courses of brush-mattresses ballasted with brick.

At the close of 1884 the work was in an incomplete state and still in the hands of the contractor.

The amount expended in operations, 1882–'84, was $157,666.61, the resulting effect being an improved channel of entrance not strictly permanent because of the incomplete condition of the jetty.

PROGRESS MADE DURING THE YEAR ENDING JUNE 30, 1885.

During July, 1884, Mr. Rittenhouse Moore placed twenty-six mattresses (each 90 feet by 30 feet by 2 feet) in the jetty; sixteen in foundation course, extending the course to 12 feet of water and to the free end as designed; ten in second course, extending that course outward from the east side of the gap where the channel for navigation crossed the jetty. This work completed the contract of September 7, 1883, the contract being closed August 2 by a final payment. The total amount of

* In addition there was appropriated in 1878 $6,000, which was applied to removing a wreck.

material used in the contract was 21,130.31 cubic yards—or, 17,653.83 yards of brush-work and 3,476.48 yards of brick ballast—for which was paid $54,998.58. The work was satisfactorily done.

The project for the expenditure of the appropriation ($25,000) of July 5, 1884, was forwarded July 21, proposing to continue work on south jetty, in accordance with the approved plan, by adding to the work superposed courses of brush mattresses and brick ballast to aid its completion, with a view to deepen the channel across the bar and maintain a suitable harbor inside the Pass.

The following proposals were received in response to advertisement of August 2, 1884 and opened August 21, 1884:

No.	Names of bidders.	Brush 6,000 cubic yards.	Ballast 1,500 tons.	Aggregate.
		Per yard.	*Per ton.*	
1	James E. Slaughter	$2 99	$3 99	$23,935
2	R. Kanters & Sons	4 00	5 00	31,500
3	A. M. Shannon & Co	3 50	4 75	28,125
4	Rittenhouse Moore	2 75	3 75	22,125

Contract was entered into with Rittenhouse Moore September 10, 1884; work to commence October 1, 1884, and to be completed June 30, 1885.

Mr. Moore began work immediately after signing articles of agreement, and pushed it so well that by the 11th of October he had completed his contract in a very satisfactory manner. Twenty-eight mattresses (each 90 feet by 30 feet) were placed in the jetty, extending the third course on both sides of the channel-gap; twelve mattresses on the west side of the gap covering a length of 360 feet, and 16 mattresses on the east side of the gap for a length of 480 feet. The amount of material used in this contract was 8,451,944 cubic yards; or 7,197,544 yards of brush-work and 1,254.4 yards of brick-ballast. The contractor received for this work $23,993.25; or $2.838 per yard.

The appropriation of $25,000 was not sufficient for thoroughly effective purposes, and the result of the expenditure of the amount was in the way of augmenting the jetty with a reasonable expectation of reaching good results in channel depth, &c., in the future by progressively slow stages in consonance with the annual grants afforded.

In his report of October 12, the United States inspector states:

> The whole work is in excellent condition. I find that the greatest amount of water at ebb tide escapes through the "gap" left for navigation and that very little of it runs over the jetty. * * * In my opinion, if the "gap" could be closed up, the bar to the northward of the jetty would deepen immediately.

PROBABLE OPERATIONS OF THE YEAR ENDING JUNE 30, 1886.

No appropriation was made by Congress for continuing improvement at this point during the year 1885–'86. The funds in hand, $851.28, are only applicable to contingencies, &c., for which the amount has been reserved. No work can therefore be outlined at this date for this improvement.

During the fiscal year ending June 30, 1887, there could be profitably expended $200,000 (the annual estimate) in continuing the work of improvement originally estimated for.

The amount required of the estimate of 1881 (not fully approved and

adopted) for the completion of improvements in accordance with the project (only approved in part) is $493,084.50.

It is located in the collection district of Brownsville, Tex., and the nearest light is Brazos Island light-beacon.

Money statement.

July 1, 1884, amount available	$34,366 59
Amount appropriated by act approved July 5, 1884	25,000 00
	59,366 59
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	58,515 31
July 1, 1885, amount available	851 28
Amount (estimated) required for completion of existing project	493,084 50
Amount that can be profitably expended in fiscal year ending June 30, 1887	200,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

T 9.

PROTECTION OF RIVER BANKS AT FORT BROWN, TEXAS.

First appropriation, 1876	$10,000 00
Second appropriation, 1879	7,000 00
Third appropriation, 1882	1,000 00
Total	18,000 00
Amount expended to June 30, 1885	16,996 46
Amount available June 30, 1885	1,003 54

The results attained at this point were not commensurate with the expenditure; therefore, in 1881 it was considered best not to attempt to control the Rio Grande at this place by artificial works, it being thought more expedient to move from time to time such of the buildings as should be in actual danger.

No further appropriation is recommended.

Money statement.

July 1, 1884, amount available	$1,230 04
July 1, 1885, amount expended during fiscal year	226 50
July 1, 1885, amount available	1,003 54

APPENDIX U.

IMPROVEMENT OF RED RIVER AND OF CERTAIN RIVERS IN THE STATES OF LOUISIANA, ARKANSAS, MISSISSIPPI, AND TENNESSEE TRIBUTARY TO THE MISSISSIPPI—WATER-GAUGES ON THE MISSISSIPPI AND ITS PRINICIPAL TRIBUTARIES.

REPORT OF CAPTAIN ERIC BERGLAND, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1885, *WITH OTHER DOCUMENTS RELATING TO THE WORKS.*

IMPROVEMENTS.

1. Red River, Louisiana and Arkansas.
2. Survey of Bayou Pierre, Louisiana.
3. Cypress Bayou, Texas and Louisiana.
4. Cane River, Lonisiana.
5. Loggy Bayou, Lake Bisteneau and the Dorcheat, Louisiana.
6. Ouachita and Black rivers, Arkansas and Louisiana.
7. Bayou Bartholmew, Louisiana and Arkansas.
8. Bayou Bœuf, Louisiana.
9. Tensas River and Bayou Maçon, Louisiana.
10. Bayou D'Arbonne, Louisiana.
11. Yazoo River, Mississippi.
12. Big Sunflower River, Mississippi.
13. Tchula Lake, Mississippi.
14. Tallahatchee River, Mississippi.
15. Coldwater River, Mississippi.
16. Yallabusha River, Mississippi.
17. Steele's Bayou, Mississippi.
18. Big Black River, Mississippi.
19. Big Hatchee River, Tennessee.
20. South Forked Deer River, Tennessee.
21. Water-gauges on the Mississippi River and its principal tributaries.

EXAMINATIONS AND SURVEYS.

22. Cassidy's Bayou, Mississippi.
23. Yazoo Pass, Mississippi, to determine the cost of a lock at that place.
24. Deer Creek, Mississippi.
25. Outlets of Bœuf River Louisiana, with a view to closing same.
26. Bayou Bartholomew, Arkansas, from present head of navigation to Lincoln County line.
27. Cypress Bayou and the lakes between Jefferson, Texas, and Shreveport, La.

UNITED STATES ENGINEER OFFICE,
Vicksburg, Miss., July 27, 1885.

SIR: I have the honor to submit herewith annual reports on the works under my charge for the fiscal year ending June 30, 1885.

Very respectfully, your obedient servant,

ERIC BERGLAND,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

U 1.

IMPROVEMENT OF RED RIVER, LOUISIANA AND ARKANSAS.

Red River has its headwaters in Northern Texas, and flows in an easterly direction, forming the boundary between Indian Territory and Texas; at Fulton, Ark., it changes its course to a general southeasterly direction, and enters the Mississippi River at Red River Landing, Louisiana.

Appropriations for the improvement of this river were made at intervals between 1828 and 1841. Between 1841 and 1852 no appropriation was made, and a longer interval of twenty years elapsed between 1852 and 1872, during which times the results of work previously done were lost.

The improvement of this river from 1872 to 1881 was carried on under various appropriations for removing raft in Red River and closing Tone's Bayou, removing obstructions from Red River, and improving Upper Red River, from Fulton, Ark., to head of raft. The river and harbor act of August 2, 1882, combined all work on this stream in the general title of improving Red River, which includes the whole river from the mouth of the Atchafalaya to Fulton, Ark., a distance of about 525 miles.

The present improvement dates from 1872. At that time navigation above Shreveport, La., was almost impossible on account of the great raft. A survey of this obstruction was made in 1871–'72, and estimates submitted for its removal and the subsequent improvement of the river. The work of removing this great obstruction was begun December 1, 1872, and November 27, 1873, the opening of the channel through the raft was completed. The work in the raft region since that time has consisted in removing portions of the old raft, leaning timber and brush from the banks, and breaking jams to prevent blockading of the river and reformation of the raft. This work has been done principally by means of crane, derrick, and snag-boats. In 1879 an examination was made with a view to ascertaining the changes in the river since the raft was opened, and it was found that the high water line had been reduced to a level generally within the banks, a greater depth of water everywhere secured, and an enlarged section of channel way gained, and that very little water was diverted from the river proper at low stages.

An examination of Tone's Bayou was made in connection with the survey of the raft region in 1871–'72. The river and harbor act of June 10, 1872, appropriated $20,000 for the improvement, the object being to improve the navigation of Red River below Shreveport, it having been seriously affected by the gradual enlargement of Tone's Bayou, the water passing into it depleting the main channel of the river below, causing it to shoal and become narrow without giving another navigable channel. The project for this improvement, submitted July 16, 1872, recommended closing the bayou with a dam, having its top 10 feet below high-water mark, in order to throw an increased volume into the main river.

As the bed of the river enlarged it was proposed to increase the height of this dam by annual appropriations until the bayou should be finally closed. This dam was completed in January, 1873, and destroyed by high water the following March. In May, 1873, it being found desirable to run drift from the Red River raft out of the navigable channel below Shreveport, the plan of running it into the bayou and closing the latter with a raft was adopted. A boom was therefore constructed and a

large raft formed at the site of the dam, but this was also entirely swept away July 8, 1873. This raft went down Tone's Bayou and thence into Bayou Pierre. A second raft was formed later in the season, but the water cut under it and consequently no valuable results were obtained. This also went subsequently with the current into Bayou Pierre.

A plan was submitted in the Annual Report of 1874 to entirely close the bayou with a dam of same height as levees along the river, and the citizens of Shreveport and others interested also urged the total closure of the bayou at that time. The dam was begun in October, 1876, and the work continued, with frequent interruptions from high water, until September, 1879, when it was discontinued for lack of funds. At this time the dam had reached a height of 24 feet, or 12 feet below high-water mark, and the top was covered with a heavy layer of stone to weight the mattresses down and prevent drift from damaging the dam.

It was found necessary to keep a watchman on the work continuously to see that the dam was not cut and prevent the people from carrying away the stone, which is a scarce article in that locality.

This dam, although really a low-water dam, was of great benefit to navigation below Shreveport. The water in 1879 reached a point 3½ feet below the low water of 1878, the lowest previously known; but notwithstanding this steamboats made regular trips from Shreveport to Grand Ecore, a thing never attempted before the partial closing of the bayou. It soon became evident that a low-water dam could not be maintained, hence, in 1880, it was proposed to put in an earthen dam up to high-water mark, just above the former, and connect its ends with the levees on Red River, and also dam the lower branch of Old River.

Contract was entered into August, 1881, for the completion of this work, which was to be finished during the low-water season of 1881; this the contractors failed to do, and on the night of December 1, 1881, the Confederate dam, built in 1864 across Lower Old River, below the projected dam, was destroyed, carrying with it the uncompleted dam above. According to affidavits of the agent of the contractors, and several of his men, on February 14, 1882, a body of masked men approached the main dam, took charge of the guards, and cut a ditch across the dam, the effect of which caused its entire destruction. The work, being incomplete, had not been accepted by the United States when the dams were destroyed, and consequently no payment was made to the contractors. In view of the determined opposition of the people in the vicinity to having the work of the Government carried out, and the probability that such work if finished would be destroyed, nothing has since been done toward closing Tone's Bayou.

The river and harbor acts of 1878 to 1881, inclusive, made appropriations for removing snags and other obstructions from Red River, Louisiana. This work, which was begun August, 1878, by the snag-boat Wagner, and continued until October, 1881, extended from the mouth to Shreveport. A shore party was also employed in 1879 to remove bank obstructions. The snag-boat C. W. Howell was built by contract and received in November, 1881. By river and harbor acts of 1879 and 1880 appropriations were made for improving the river from Fulton, Ark., to head of raft. An examination of this part of the river was made, and report thereon submitted in 1879. At the same time a report was submitted on an examination of the stream above Fulton to the Missouri, Kansas and Texas Railroad Bridge.

In 1875 some leaning timber was cut between the head of raft and a point 24 miles below Fulton. Work was begun in September, 1879, at Fulton, and continued down-stream until December. The work was

resumed in September, 1880, and continued until high water in December. The river was placed in good navigable condition, when there was sufficient water for boats to run, by the work of these two seasons, but as many new obstructions were added by the flood of 1881, the balance of appropriation for this work, with a portion of that for improving Red River, was used in their removal.

In September, 1874, a survey was made of the falls at Alexandria; another was made in 1878, and report thereon submitted December 20, 1879, with a project for excavating a channel 75 feet wide, with a permanent depth of 4½ feet below the low water of 1874, through the upper falls, and for building a dam at the lower falls with the rock removed from the channel above. The work of excavation was let by contract, October 14, 1882, at $3.45 per cubic yard, and has progressed very slowly since that time, but 2,050.7 cubic yards having been excavated and paid for to June 30, 1884. During the seasons of 1882–'83 and 1883–'84 the United States snag-boat C. W. Howell and United States steamer Thomas B. Florence were employed in removing obstructions below and above Shreveport. During the latter part of 1882 the United States snag-boat John R. Meigs was temporarily transferred to this river from the Yazoo to replace the Howell while the latter was undergoing repairs.

An examination of Bayou Pierre, Louisiana, was made in February and March, 1883, with a view to determining the practicability of removing the raft from the bayou to improve the low-water navigation of Red River between Tone's Bayou and Bayou Winsey. The work done from 1872 to the beginning of this fiscal year has been of great benefit to navigation and commerce. Previous to 1872 navigation above Shreveport was prevented by the great raft, which has been removed, and, with subsequent work, about 150 miles of river opened to navigation. By means of snag-boats and shore parties numerous obstructions have been removed, the raft kept from reforming, and the river kept open from Fulton, Ark., to its mouth, and is navigable between those points the entire year. The work at the channel through the falls of Alexandria was but little more than one-fourth completed.

The present project for the improvement consists in the removal of snags and other obstructions, deepening the water at shoal places, and opening the channel through the falls at Alexandria. New obstructions are continually added by caving banks, &c., and each flood brings down a large quantity of obstructions; hence no detailed estimates for the permanent improvement of the river can be presented. During the fiscal year the work has been carried on as follows: The United States snag-boat C. W. Howell, after undergoing some necessary repairs at New Orleans, returned to the river and resumed operations August 24, 1884, which were continued below Shreveport until February 6, 1885. From February 10 to March 1, 1885, she was employed in Upper Red River, between Shreveport and Garland City, Ark.

The following work was performed:

Snags pulled	1,238
Stumps pulled	52
Side-jams removed	5
Shore-snags cut	1,079
Leaning trees cut	26

The shaft of one wreck and hull of another were removed. The United States steamer Florence, which sank at O. K. Bend, was raised and towed to the mouth of the river. For details of the operations of the

Howell, I would call attention to the report of Capt. E. F. White, submitted herewith.

The United States steamer Thomas B. Florence left Alexandria, La., August 24, 1884, to proceed to Upper Red River and resume operations. While crossing O. K. Bar, about 70 miles above Alexandria, August 25, 1884, she struck a submerged snag which broke through her bottom, and she sank on the bar in a few minutes. The Howell came to her assistance, arriving August 27, but did not get her afloat until September 6, after her cabin had been swept away and the heavy parts had been removed. Authority having been obtained, she was towed to the mouth of the river by the Howell in November, and from there was taken to Saint Louis to undergo repairs. On completion of repairs she returned to Red River, arriving at Shreveport April 15, 1885. On April 28 the Florence was sent in the upper river to break up a large jam of logs which had formed there, but after removing part of the jam it reformed below the boat, and the Howell was also sent to assist in removing the obstruction.

The Florence was employed from April 28 to May 15, and the Howell from May 2 to 11. This work was in the old raft region, where the river in many places is only 90 to 100 feet wide, and jams are easily formed, which, if not removed during high water, are very difficult to break afterward. It is estimated that from 4 to 5 miles of jams were removed and a serious obstruction, which would have been a complete barrier to navigation, was only averted by the promptness of its removal.

The following obstructions were removed in breaking the raft:

Jams removed	15
Side-jams removed	12
Snags pulled	3

During the low-water season, from September till the early part of December, 1884, three parties were employed under the superintendence of J. T. Dorey, whose report is submitted herewith, in removing obstructions from the banks of the river, &c., between the mouth of Loggy Bayou and the Arkansas State line, accomplishing the following work, viz:

Channel snags cut off at low water	3,055
Shore snags cut	25,772
Stumps cut	3,128
Leaning trees cut	6,289

Five thousand eight hundred and eighty-nine rods of willow brush, averaging 6 feet in width, were also cleared from the banks.

The work by the snag-boats and shore parties during the past season has relieved the river of many dangerous obstructions, kept it open for navigation, and prevented the serious blockading of the stream in the old raft region.

SALE AND MURPHY DAM.

The river and harbor act approved July 5, 1884, provided that of the appropriation for Red River an amount not exceeding $5,000 should be expended to close the outlet of the river known as Sale and Murphy's Canal. Above Shreveport, in what is known as the raft region, there are numerous large lakes in the bottom lands on both sides of the main stream, connected therewith by bayous or outlets. These outlets are of two kinds, natural and artificial. The lakes and outlets were used, at the time the river was obstructed with the rafts, as avenues during high stages of the river for passage of steamers to the head of the raft

in the main river. As the different rafts formed successively up-stream the lower bayous or outlets were abandoned for the newer ones formed above. If these were not of sufficient capacity for the purposes of navigation they were cleaned out and enlarged, or else short canals were dug at convenient points so as to form the necessary connections between the river and the lake channels. Such are Alban's canals, Nos. 1, 2, and 3, on the east side, and Sale and Murphy's, Kountz's, and Hervey's canals on the west side of Red River. Heavy tolls were charged boats for passing through these canals. The removal of the raft by the Government opened up the main channel of the river, since which time the outlets have not been used for navigable purposes, and their mouths have gradually filled up with deposit and drift, so that at low stages but little water is drawn off from the main stream through them. At high stages, however, they vent a considerable volume, and their closure would tend to enlarge and improve the navigation of Red River.

The upper outlet on the west side is the Sale and Murphy Canal, about 70 miles above Shreveport by river. The country bordering the river in the vicinity of this outlet is sparsely settled and could not be depended on to furnish laborers and supplies necessary for the work of building the dam. Consequently it became necessary to transport these from Shreveport by steamer. When the appropriation became available the water above Shreveport was too low to permit boats to run up as high as the mouth of the canal, and it became necessary to delay the work until a sufficient rise should occur. About the 1st of November a light-draught steamer was chartered, laborers, tools, and supplies taken on board, and the boat started up the river, arriving at the mouth of the canal November 5. Capt. J. T. Dorey, who had previously visited the locality and inspected the site, was the superintendent in charge of the work, and accompanied the party on the boat. He had other duties to attend to also, and after starting the work on the selected site he left the party in charge of an overseer who was supposed to be reliable and familiar with such work. The superintendent paid occasional visits while the work was in progress.

April 4, 1882, Maj. W. H. H. Benyaurd, submitted to the Department estimates for closing this and other outlets with dams composed of brush and stone, with mattress protection on bottom and sides to resist the scouring effect of the water. The estimate for the Sale and Murphy Dam was $6,900. This amount not being available, and it being then impracticable to obtain stone for the work, it was decided to build the dam of brush mattresses and earth. It was necessary to push the work to completion as rapidly as possible, as the winter rise could be expected on or before the 15th of December.

About the end of November I was informed that the dam was nearing completion, and in order to satisfy myself that the work had been properly done I directed Assistant Engineer H. M. Marshall to proceed to the work and inspect it. He directed that the height should be increased and base made thicker, which was done, and the working party was withdrawn on December 4.

The dam when completed was 400 feet long, had a crown of 10 feet, with slopes of 2 to 1. Its top was 2 feet above high water, with wing levees of the same height extending 60 feet from each end, the outer ends of which were protected by timber and plank. The assistant engineer who inspected the dam reported that it was to all appearances a substantial structure. December 25, I was informed that the dam had been destroyed. In order to ascertain the extent and cause of the in-

jury, I directed my assistant engineer to proceed to the locality. He reached the sit of the dam on the 1st of January, and found the whole structure gone, except the wings on top of the banks. The canal was then full of water flowing with a strong current.

From the 1st to the 31st of December the river at Shreveport had risen steadily from 5.10 inches to 21.75 inches on the gauge. What the rise was at the site of the dam for the same period cannot be ascertained, but it must have been much more rapid in the narrower channel above, and probably reached the top of the bank several days before the end of the month. This threw a pressure of over 12 feet of water against the dam. Had the dam been properly constructed and firmly compacted it would easily have withstood such pressure.

During the construction of the dam persons living in the vicinity had been heard to declare that it would not be allowed to stand in case the land above was overflowed. It was also known that works like this had formerly been destroyed both above and below Shreveport. When the dam was reported broken it was therefore suspected that it had been maliciously destroyed. Subsequent investigation has failed to verify this suspicion, but, on the contrary, the evidence obtained from several persons seems to establish the fact that the overseer in charge of the work during the necessary absence of the superintendent had not obeyed instructions, but had put into a portion of the foundation a number of large logs and a greater quantity of brush than the superintendent had authorized. In justice to the overseer it should be stated that he emphatically denies the charge, nor is it evident why he should have attempted to hurry and slight the work, as he was paid by the day and not by the job. Such faulty construction would necessarily produce sepage through the freshly-constructed dam, which, on the rising of the river, would occasion the collapse of the whole structure.

The amount expended on the Sale and Murphy Dam was $3,213. The benefit to navigation from closing Sale and Murphy's Canal would not be appreciable as long as there are a number of outlets between this and Shreveport.

The closure of all the outlets would tend to improve the navigation of Red River throughout this reach, but they would not *alone* entirely reclaim the land, from the fact that the floods of Red River along this reach go over the banks, and therefore, for the accomplishment of the latter object, it would be necessary, in addition, to build a continuous levee along both banks of the river. If the closure of all of these outlets is contemplated, I would recommend that they either be all closed in one season or that the work be carried on progressively from the lower to the upper.

At Alexandria, La., the work has been in local charge of Assistant Engineer J. W. Beaman, whose report is submitted herewith.

The work of excavating the channel through the upper falls at Alexandria, under contract of October 14, 1882, has progressed slowly during the year. From September to December, inclusive, drilling and blasting were continued, but only a small quantity of rock was removed. No work whatever has been done since January 20, 1885. March 21, 1885, the contract was modified to allow a payment of $5,000 to the contractor for the quantity of rock drilled and blasted but not removed (estimated at 3,500 cubic yards), and the payment has been made. The last extension of the contract expires October 1, 1885, before which time it is expected the work will be completed. To the dam across the

west chute, at the lower falls, 445 cubic yards of rock and earth were added during the year.

PROTECTING THE HARBOR AT ALEXANDRIA, LOUISIANA.

The river and harbor act of July 5, 1884, directs that of the appropriation for improving Red River not exceeding $15,000 shall be expended for "revetment to protect the harbor at Alexandria from damage by the current of the river."

My predecessor submitted a project for this work which was approved July 26, 1884. This project contemplated the building of a mattress revetment against the graded bank from the stone dam at the lower falls to Fisk street, the revetment to extend from the foot of the bank to high-water mark. In order to carry out this project it would have been necessary to grade the bank to a slope of about 2½ horizontal to 1 vertical. This grading along the city front would have destroyed some valuable private property, which the owners refused to sacrifice without compensation. The estimate put upon this property by the owners was about $5,500. As the act referred to does not contemplate any payment for damage to private property it appeared that the projected work could not be carried out without further legislation. The citizens of Alexandria were anxious that something should be done for the protection of the bank before the season of high water the following winter and spring. Consequently, with the assistance of Assistant Engineer H. M. Marshall, a modified project was drawn up, submitted to and approved by the Chief of Engineers.

In this project it was proposed to build a crib and stone wing-dam and training-wall, the former starting from a point of the bank a short distance above the head of Madison street; the wing dam to be 160 feet long, with crest 10 feet above zero of the gauge, extending from the 10-foot contour line on the bank and making an angle of about 45 degrees with the normal to the bank; the training-wall to be 360 feet in length and 10 feet above zero, extending from the toe of the wing-dam and approximately parallel with the top of the bank. The estimate for the work was $14,309.15. The work was begun November 17, 1884, under the local charge of Assistant Engineer J. W. Beaman, whose intelligent management and efficient services I cheerfully acknowledge. Under his supervision the work progressed satisfactorily until the 28th of December, when a sudden rise of 25 feet of water in three days put a stop to construction, and high-water has prevented resumption of the work since that date. When work was suspended the wing-dam had been completed and 60 feet of the training-wall was completed to within 6 feet of its crest. A crib had also been placed in position and lashed to the more stable portion of the wall but not fully ballasted. There remains to be completed the back apron of the dam and 280 feet of the training-wall; also, the incomplete portion of the first 80 feet of the training-wall.

During January, and up to the 15th of February, a force of men and teams was employed in quarrying rock and depositing it on the high bank, above the lower falls. All logs cut were also hauled to the same point. These materials are ready for quick delivery at the training-wall as soon as the stage of water will warrant the resumption of work. Sufficient materials are on hand for completing the dam and training-wall, with possibly the exception of rock. As the stone dam at the lower falls has not yet been completed, owing to the failure of the contractor to finish the excavation of the channel through the upper

falls, and as the training-wall of the new work was incomplete, it was to be expected that there would be some caving of the bank during and since the high water of December.

The average amount of caving between Monroe and Beauregard streets has been 16.8 feet.

Until the completion of the dam at the lower falls it is uncertain what its exact effect upon the regimen of the river below Bayou Rapides will be. Nor is it certain that the wing-dam and training-wall when completed to the height of 10 feet on the gauge will cause a deposit sufficient to protect the bank as far down as Beauregard street. It may be necessary to increase their height, and also to build another spur-dam further down, say at the foot of Elliott street. For these purposes it is recommended that an additional amount of $10,000 be appropriated.

The wing-dam and training-wall under the present project and appropriation will be completed as soon as the river falls sufficiently to enable the work to proceed economically. The amount available for next fiscal year will be used to complete the projected work at Alexandria Harbor, to care for the property stored at Shreveport and Alexandria, and to reserve a portion for use in removing jams next winter and spring. During the coming low-water season but little, if any, work can be done. With the amount asked for the fiscal year ending June 30, 1887, it is proposed to continue the improvement of the river by means of snag-boats and shore parties below and above Shreveport, to complete the improvement at the falls of Alexandria and extend the work for the protection of the harbor at Alexandria, if authority be granted for such extension. It is also deemed advisable that a survey of Red River be made from Fulton, Ark., to its mouth. This survey would be of the utmost importance in determining the future methods of improving the river. An estimate for the survey has already been submitted to the Department. The amount of the estimate is $45,000, but if the completion of the survey of Bayou Pierre be authorized as contemplated, this estimate may be reduced to $40,000 (as the latter survey includes a portion of Red River), provided the amount becomes available early in the season.

Appropriations aggregating $535,765.50 were made at intervals between the years 1828 and 1852. The present improvement dates from 1872, and the following amounts have been appropriated:

By act approved June 10, 1872, for improving Tone's Bayou	$20,000 00
By act approved June 10, 1872, for removing raft	150,000 00
By act approved March 3, 1873 for removing raft	80,000 00
By act approved June 23, 1874, for removing raft	50,000 00
By act approved March 3, 1875, for removing raft	20,000 00
By act approved August 14, 1876, for removing raft and closing Tone's Bayou	35,000 00
Allotment August 27, 1877, for closing Tone's Bayou	4,500 00
By act approved February 7, 1878, for removing raft, &c	6,000 00
By act approved June 18, 1878, for removing raft and closing Tone's Bayou	24,000 00
By act approved June 18, 1878, for removing snags and other obstructions.	25,000 00
By act approved March 3, 1879, for removing raft and closing Tone's Bayou	15,000 00
By act approved March 3, 1879, for removing obstructions	22,500 00
By act approved March 3, 1879, for improving upper river from Fulton, Ark., to head of raft	10,000 00
By act approved June 14, 1880, for improving upper river from Fulton, Ark., to head of raft	10,000 00
By act approved June 14, 1880, for the removing raft and closing Tone's Bayou	25,000 00
By act approved June 14, 1880, for removing obstructions	60,000 00

By act approved March 3, 1881, for removing obstructions	$10,000 00
By act approved March 3, 1881, for removing raft and closing Tone's Bayou	10,000 00
By act passed August 2, 1882, for improving Red River	75,000 00
By act approved July 5, 1884, for improving Red River	75,000 00
Amount appropriated since 1872	727,000 00
Amount expended to J ne 30, 1885 (including outstanding liabilities)	714,027 67

Money statement.

Amount appropriated by act approved July 5, 1884		$75,000 00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$62,012 80	
July 1, 1885, outstanding liabilities	14 87	
		62,027 67
July 1, 1885, amount available		12,972 33
Amount that can be profitably expended in fiscal year ending June 30, 1887		90,000 00
And, in addition, for survey of Red River, Louisiana and Arkansas		45,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

REPORT OF CAPTAIN E. F. WHITE.

UNITED STATES SNAG-BOAT C. W. HOWELL,
Shreveport, La., May 26, 1885.

CAPTAIN: I have the honor to submit the following report of operations of the United States snag-boat C. W. Howell, in Red River, Louisiana and Arkansas, from July 10, 1884, to March 1, 1885. Under instructions from Major Miller, I commenced work on July 10, 1884, fitting the Howell for service, and on the 15th started for Upper Red River to do some work. On the 17th I returned to Shreveport, and the following day started for New Orleans to have some necessary repairs done to the boat.

On the way down some necessary snagging was done. On the 21st New Orleans was reached, and the boat made fast on the Algiers side at 10.30 a. m. Without delay work was begun, engineers repairing and refitting their department, carpenters putting in new bulkheads, decking, &c. August 1 the boat went into the marine dry dock; the bottom was repaired, three new plates put in, scraped, and the plating coal-tarred. On the 9th she was let out and towed to the foot of Girard street, on the New Orleans side.

On the 13th, the repairs being completed, we started for Alexandria, under orders from Major Miller to await his arrival there, and reached the upper falls August 16, where we lay until August 23, when Major Miller and Captain Bergland reached the boat on an inspection tour, and remained until the following day. Acting under instructions from you I began snagging at once, but worked one day only, when a messenger from Captain Dorey reached us and reported the United States steamer Thomas B. Florence sunk and in need of immediate help. The boat started at once to her assistance, and on the morning of the 27th found her on the O. K. Bar, sunk. Every means in our power was enlisted to save her, but not until September 6 did I get her afloat, and then only after the cabin had fallen off and everything heavy had been removed. She was then placed in a safe position, in charge of a watchman. From September 8 until November 12 the boat continued snagging from O. K. Bar to Montgomery, without the loss of a day.

On November 12, under your instructions, the *Howell*, in charge of J. H. Lewis, took the *Florence* in tow and started for the mouth of Red River, and on the 17th left her there in charge of the watchman sent by you. The *Howell* then started back up the river, working as she went, until Saint Maurice was reached. As a result of this work it may be said that up to this point the river has, perhaps, never been so free from snags or obstructions of any kind. On Sunday, December 28, rains of unprecedented extent began. In twenty-four hours the river rose some 20 feet, putting a stop to such low-water work as had been done heretofore. The rise, however, enabled the boat to reach other important work, but its continuation diminished the boat's usefulness. January 20, 1885, the boat arrived at Shreveport, and I again took charge. Under your instructions we started down-stream, removing all floating obstructions, and

reached Cotile January 30. From that point I telegraphed you that the work was too much scattered and would not justify the expense of continuing.

On February 2, I received your telegram instructing me to return to Shreveport, stopping at Cotton Point to take on the Bayou Pierre survey property, which we did, reaching Shreveport on the 6th.

On the 10th under instructions from you, and at the request of steamboatmen, I proceeded to Upper Red River, removing jams and snags. The work was carried as far as Garland City, Ark., when the river suddenly began rising. I then concluded to suspend operations, as it was impracticable to do further efficient work, and return to Shreveport, La., which I did, and laid the boat up under your instructions, keeping only a reduced crew, that the boat might be in readiness in the event of a jam occurring in the raft region.

I would respectfully recommend that the *Howell* be sent to Upper Red River when the water is at a proper stage, to work from Garland City to Fulton, Ark., that part of the river having never received the attention due it, and is very dangerous to navigation, especially at night.

After the above work is completed, or should the *Howell* be withdrawn because of high or low water, she could be sent to the wreck of the *Era No. 7*, at Cotton Point, to resume the work left by her at the close of the season of 1883, and work toward Shreveport. This part of the river is very narrow, and the bed is full of logs, the removal of which would allow the bottom to scour and enlarge the channel, thereby, I believe, affording great protection to the banks and lessening the necessity for levers.

In Upper Red River, the island known as Rush Point Tow-head and several others in the middle of the river catch the drift coming down, thus forming jams and obstructions to navigation. Their removal by dredging would reduce the expense of removing subsequent obstructions, or obviate it entirely by straightening the river.

I would further recommend that a small steamboat of, say, 16 feet beam, by 75 feet long, of 12 inches draught of water, to cost not exceeding $800, be purchased or built, to act as a tender for this boat when at work, as a great deal of expense and valuable time, especially at dead low water, is lost in going to and fro for fuel and supplies, often necessitating a stoppage of work while the crew is away in the skiffs. During the past reason it became necessary to transfer wood in skiffs, as the water was too low to admit of the steamer crossing the bars without first removing the logs and drift. Such a boat could be manned by the crew of the *Howell* when needed; the extra expense would be for a watchman when she was not in service.

I was absent from the *Howell* from September 6 until October 15, 1884, under your orders, arranging for repairs to the steamer Florence; from that date until November 24, on account of sickness, and from November 24, 1884, to January 20, 1885, while acting as inspector on the *Florence*, then undergoing repairs at Saint Louis, Mo. During my absence she was under the command of J. H. Lewis, and the work done was very satisfactory to steamboatmen.

At different points on the river were found great masses of logs, varying in circumference from 6 to 18 feet at the butt, and 60 to 120 feet long, requiring several saw cuts before removal. Notably was this the case at Montgomery, O. K. Reach, Black Hawk, Topeka, Dunn's Bend, O. K. Bend, Coco Point, Mirabeau Reach, Prudhomme's Bend, S. P. Landing, Saint Maurice, Closo Point, Rosa Bar, and Le Compte's. There was, indeed, not a mile of river in which no work was found. At many points hundreds of logs were piled together, throwing the current against the banks and entailing serious loss to the owners. In every such instance we have succeeded in restoring the channel to its former location and stopping the caving bank.

At Montgomery the removal of a large bed of logs opened a new and better channel, and apparently prevented great injury to the town thereby, as the current set against and was undermining the bank on which it is located.

The following is a summary of the work done during the season:

Snags pulled	1,238
Stumps pulled	52
Side jams removed	5
Shore snags cut	1,079
Leaning trees cut	26

Steamer Lizzie Hopkins's shaft removed; steamer Gossamer's hull removed; United States steamer T. B. Florence, sunk in O. K. Bend, raised and towed to the mouth of Red River.

Very respectfully, your obedient servant,

E. F. WHITE,
Captain United States Snag-boat C. W. Howell.

Capt. ERIC BERGLAND,
Corps of Engineers, U. S. A.

REPORT OF MR. J. T. DOREY, SUPERINTENDENT.

MEMPHIS, TENN., *May* 22, 1885.

CAPTAIN: I have the honor to submit the following report of work accomplished under my supervision on Red River, Louisiana, for the year ending June 30, 1885. The work under my charge on Red River during this season has been principally above Shreveport, and such work as could only be accomplished during the low-water season, embracing that portion of the river from Shreveport to the Arkansas line, and below Shreveport to Loggy Bayou.

The peculiar character of this part of Red River requires constant attention, and has since the removal of the raft by Lieutenant Woodruff in 1873. Very little work was necessary with the *Florence* this year on account of the light run of drift, and the work was confined to cutting and pulling out such obstructions as were exposed at the low-water stage. The water being very low in September, and in compliance with your orders, I began work, my object being to use as large a force as possible and complete it before the river rose. I organized three shore parties and began work by dividing the distances from Shreveport to the Arkansas line into three parts.

The party on the upper end was quartered on a small steamboat; this was done on account of the isolated portion of the river from the Arkansas line to Gilmer and the impossibility of getting drinking water, except at Gilmer, for the laborers, made it necessary to have a boat to carry a week's supply of water, as the river water was so brackish that it was not fit to drink. The two parties on the lower portion were in camps of twenty-five laborers each.

My operations began at Gilmer, using steamer Alpha for quarters. It was necessary to work over this portion especially with as much dispatch as possible before there was a rise, the water at this time being very low. This being the first attempt at work of this character above Gilmer since the raft had been cut out, it was not my object to make a thorough piece of work of it, but only to cut those snags which were most in the way during low water, especially the dangerous ones on the points.

The distance from Gilmer to Bargetown, about 30 miles, was worked over in ten days; then the boat worked her way out. The entire distance worked over during the season by the three parties was 150 miles, extending from 70 miles below Shreveport to 80 miles above. The total amount of work accomplished from September to December 7, 1884, was as follows:

Snags cut off at low water	3,055
Stumps cut	3,128
Shore snags cut off	25,772
Leaning trees cut	6,289
Rods of bank cleared of willows	5,889
Days' labor	4,197

The season was especially favorable for the work on account of the low stage of water. During low stages the snag-boats when in operation are under heavy expenses, and it is economy to pass over a great distance, removing such obstructions as cannot be removed by shore parties. Hence the advantages of working parties on shore. They assist the snag-boats in doing more effectual work; they lessen the number of floating obstacles, and more labor can be operated at less cost than with the boat alone.

I would respectfully recommend that there be $20,000 allotted to the improvement of Red River from Fulton, Ark., to Shreveport, La., $8,000 to be used by shore parties and $12,000 used for working the steamer Florence, when practicable. From Shreveport to Loggy Bayou there is sufficient work for shore parties to expend $5,000; below this point I am not sufficiently posted to estimate the cost of shore work. The season for shore parties to operate embraces the months of August, September, and October, and in some years November and December. The months of April, May, June, and July are likely to call out the boats for service, keeping the drift broken up to prevent jams, which, when left for any length of time, become serious obstructions very difficult to remove.

It is not necessary to keep the *Florence* continually at work above Shreveport, but by close observation as to the rise and fall, the river can be kept open by making trips through the raft region and removing side jams as the water begins to fall, and leaving the banks clear of rack heaps so that the drift may have a clear run during the next rise. This system of improvement has met the approval of those interested in the navigation of Upper Red River, and has been recommended by all the most reliable river men.

Hoping my work has so far met with your approval, I am,

Very respectfully, your obedient servant,

J. T. DOREY,
Superintendent.

Capt. ERIC BERGLAND,
Corps of Engineers, U. S. A.

REPORT OF MR. J. W. BEAMAN, ASSISTANT ENGINEER.

ALEXANDRIA, LA., *June* 30, 1885.

SIR: In accordance with request contained in your letter of the 13th instant, I have the honor to submit the following report of operations at this point during the past fiscal year. The works of improvement under my charge are three:

I. The excavation of the channel through the Upper Falls of Red River.

II. The construction of a wing-dam across the west chute at the Lower Falls, and, in connection with this, the removal of a low-water dam thrown across the middle chute in 1881 by the old Red River Line Steamboat Company, of New Orleans, La.

III. The construction of a wing-dam and training-wall for the protection of the city front and the improvement of the harbor of Alexandria.

I.—UPPER FALLS.

The progress in the work of improvement at the Upper Falls has not been all that it should have been, still there was an evident effort on the part of the contractor, Mr. E. P. Doherty, to carry forward the work in good faith. The difficulties of this work are most perplexing and trying. Large sedimentary deposits, up to 4 feet in depth, not washed away until the extreme low-water current has acted upon them; steamboats passing almost every day during the first of the working season, and the swiftness of the current over the falls, are some of the sources of trouble which render this undertaking both difficult and dangerous. During the month of July the range lines and the level benches were established.

August 1, Mr. J. R. Johnson, the representative of Mr. E. P. Doherty, reported to me. He at once employed men and was occupied until the 29th of the month in building flat-boats and a platform upon which to place the drilling appliances provided for the work.

August 15, an examination was made of the condition of the channel between Sections 0 and 22 north. Over this area the dredge-boat Thos. J. Herndon had operated between the dates December 1, 1883, and April 17, 1884. The previous examination of this portion of the channel was made February 9, 1884. Between that date and April 17, following, considerable material was dredged and transferred to the Lower Falls dam. The determination of the amount of excavation had been rendered impossible by the extreme high stage of the river. The data obtained by this August survey indicated a total excavation of 1,218.4 cubic yards of rock removed by the dredge Herndon during the previous fiscal year. Large deposits of sand were distributed over this area, and borings up to 2 feet had to be taken in order to secure the data upon which this estimate is based. The February 9 examination indicated a a total excavation within the same limits of 1,162.9 cubic yards, which indicates either very little excavation of rock in place, after that examination, or that the fill produced during the falling water after the annual rise so interfered with the work of sounding as to falsify the indication of work done by the dredge after the February examination. I am disposed to think that the truth is between the two hypotheses, and that owing to the sand deposit the auger in all cases did not reach through it to the bottom of the excavation.

After the 29th of August blasting operations were carried on, and no dredging was done until the 22d of December. On that day the dredge-boat Cincinnati Belle was placed upon the work. After six days dredging high water put an end to her effectiveness, and very little dredging was done after December 28. She remained at this point until the 20th of January following. During her stay she dredged about 415 cubic yards of rock, mud, and sand (estimated measurement in the scow) from the same area over which the Thos. J. Herndon had previously operated. What proportion of the dredging was rock material displaced by blasting, and what recent sand deposit, it would be difficult to accurately estimate. It is fair to assume that the greater portion was rock displaced by blasting—probably 300 cubic yards would be a fair estimate of the amount. Soundings taken while this dredge was at work indicated that the channel bed had not been thoroughly broken up to grade line by the blasting operations. Approximate data with reference to the status of excavation at the Upper Falls may be tabulated as follows:

	Cubic yards.
Excavation previous to December 1, 1883	137.8
Excavation by Thos. J. Herndon, December 1, 1883, to April 17, 1884	1,218.4
Excavation by Cincinnati Belle, December 22, 1884, to January 20, 1885	300
Excavation under the contract to date	1,656.2
Projected excavation as per estimate of August, 1883	7,842.6
Projected excavation uncompleted	6,186.4

Blasting operations were continued from August 29 until December 23. The whole of the north portion of the projected improvement from Section 0 to Section 22 was worked over, also a strip of 20 feet wide from the west boundary line, and 480 feet long from Section 0 to Section 16, south. There remained unworked by blasting or dredging the area 55 feet wide from the east boundary line, and 480 feet long from Section 0 to Section 16, south, and the triangular space between the two portions of the work. The drill more used was an Ingersoll "Eclipse," with 3⅛-inch cylinder, with variable stroke. Another drill, the "Dynamic Rock," J. Mason & Co., manufacturers, with same size cylinder, was also used to some extent, but its working was somewhat less satisfactory and reliable than the Ingersoll.

The drilling plant consisted of a flat-boat 28 feet long, 18 feet wide, and 2 feet 3 inches in depth. Upon this was placed a small upright boiler, and connected with this by ropes a platform or raft 28 feet long by 14 feet wide. Upon this was the drill and other drilling and blasting appliances. In the working of this plant a crew of six men was employed, a man to run the drill, two platform men to assist him, an engineer to look after the boiler, a man in charge of the dynamite and the blasting, and one skiff man.

In drilling, the tripod was usually placed near one side of the platform, the drill rod just clearing the upper outer edge of the platform. In other words, the drilling was done from the platform, and not through it. Each hole was drilled at an angle of 45 degrees with the horizon, and to a point 1 foot below the grade line of the excavation. A hole 5 feet deep could be drilled in ten minutes, under favorable conditions; but considerable trouble was experienced from the gravel which the swift current was constantly sweeping into the hole, choking it up, and clogging the action of the drill. As soon as the hole had been drilled, a hand-pump, made out of tin, 2¼ inches in diameter, with ordinary flap valve, was inserted, and the hole cleaned out.

The charge of dynamite, inclosed in a cylinder 2 inches in diameter with its insulated wire attachment, was then passed down through the pump barrel, the pump withdrawn, and the wire made fast to the top of a pole standing in a hole drilled for its reception near the center of the area to be blasted out. The sediment of the river, gravel and sand, filled the hole, and no other tamping was employed.

Nine holes, from 4½ to 5 feet apart, were thus drilled and loaded. The wires were then all removed from the pole, the connections made with the insulated wire cables, the platform and flat-boat drawn by means of a windlass at the bow of the flat-boat, about 30 feet from the charges, the cables connected with the two poles of the exploder, a Laflin and Rand machine, and the charges exploded. Two sets of nine holes was a fair day's work. The nine holes were arranged in two parallel lines, five in one, and four in the other, each one of the four holes opposite a space in the other line, as follows: ° ° ° ° ° °. The cartridge cans were 2 inches in diameter, made of common sheet-tin, and of different lengths to suit the charge. Atlas powder, 75 and 40 per cent. nitro-glycerine, was mostly used. The commercial candles of dynamite were emptied out of their paper envelopes. This loose powder, loaded into the cans, was tamped with a wooden rod, a hole was made to the center of the mass, the platinum fuze inserted, the hole filled with dynamite, the top of the can closed with a tight-fitting cork, and soap or pitch smeared over cork and can at their intersection (the insulated fuze wire passing out at the side between the cork and the can), and the cartridge was ready for use. In the deepest holes, which were about 5 feet in depth, 2 pounds of 75 per cent. dynamite was the usual charge.

During the season 2,075 pounds of dynamite of different degrees of strength, 40, 50 and 75 per cent. nitro-glycerine, were used. The season was an exceptionally long one, and more could have been accomplished had the contractor been at work blasting on the 1st instead of the 29th of August. All the blasting could have been completed, and at the lowest stage of water a light-draught dredge could have removed the rock displaced, when there was no interference from passing steamboats, which during the cotton season are an almost constant source of annoyance, and much time is lost for this reason. The superintendent representing the contractor during the greater portion of the working season was Mr. Charles H. Taliaferro, who deserves much credit for the intelligence manifested in the discharge of his duties.

II.—LOWER FALLS.

September 1, a party of three men was employed in clearing the middle chute at the Lower Falls of the rock remaining after the dredging operations of November, 1883. Soundings taken on September 23 indicated that this channel was entirely cleared of all obstructions. Soundings both above and on the line of the dam removed showed a very uniform depth, varying but little from 3.6 feet. Soundings on a line below the site of dam, and on line with Bailey's Dam, showed a depth varying but little from 3.5 feet, the Alexandria gauge indicating exactly 2 feet of water above the low-water level of 1881. The rock removed was deposited on the dam

across the west chute. The 415 cubic yards of dredgings removed from the Upper Falls in December and January were deposited on the west wing of the dam across the west chute at the Lower Falls; this, with about 30 yards removed from the middle chute and deposited on the east wing, makes in all deposited in the water over the site of the dam 445 cubic yards of dredgings, rock, mud, and sand.

III.—ALEXANDRIA HARBOR.

The projected improvement of the Alexandria Harbor contemplates the protection of the right bank of Red River from the Lower Falls to the head of Beauregard street. This is a concave bend, which has been wearing away steadily since the construction of the Bailey Dam by the United States Army in the spring of 1864. This structure has no doubt had such an effect upon the regimen of the river as to increase most seriously this caving of the bank. The reason for the project recommended by you, and approved by the Chief of Engineers, is set forth in your letter to the Chief of Engineers under date of October 24, 1884. The conditions existing at that date and the plan of improvement as set forth in the same communication are as follows:

There has been very little change in the low-water shore-lines since 1874 between Bayou Rapides and Madison street, while below Madison street the distance between the contours of the top of the bank and low water has lessened. These effects are probably due to the erosion of the bank along the upper portion at time of high water, the bank there containing a large proportion of sand, and to the undermining action along the lower part, the bank here being stiff clay on a stratum of quicksand overlying a soft sandstone at the zero water-line. The erosion of the bank along the upper portion will probably cease on completion of the dam under progress at the Lower Falls. To prevent the undermining of the lower portion referred to above, it is proposed to build a crib and stone wing-dam and training-wall in the position shown on tracing, the wing-dam to be 160 feet long, with crest 10 feet above zero of the gauge, extending from the 10-foot contour line on the bank, and making an angle of about 45 degrees with the normal to the bank, the training-wall to be 360 feet in length and 10 feet above zero, extending from the toe of the wing-dam and approximately parallel with top of bank. The details of construction are as follows:

Foundation.—Log cribs, 20 by 30 feet in the middle and 20 by 20 feet in the aprons, with height equal to depth of water at zero of gauge. A platform of eight logs is built on the first layer of logs at the center of the crib and longitudinal to the dam. Five logs about 5 feet apart and parallel to the platform to be placed on each round of logs of the crib. No two of these logs to be in the same vertical plane. Logs of the cribs to be notched down and drift-bolted at the corners. The transverse logs, except in the aprons, to be fastened together, two and two, with 36-inch bolts 1 inch in diameter, washers at top and bottom, and a nut. To be built in place and sunk with rock placed on the platform, then the whole filled with rock. Where the foundation is not in water, as on the side of the bank, this foundation may be omitted, and the cribs built on the ground, a platform being placed on the bottom logs, and the five logs on the next two rounds of logs. Riprap to be placed on the bank at front and back of the dam and crib filled in with 6 feet of riprap.

Dam.—To be built over the center of the foundation and in cribs 20 feet long, 30 feet base, 15-feet crown, slope 1½ on 1 on the upper side, and vertical on the lower. Logs notched and dritt-bolted at corners, and transverse logs bolted as in foundation. The bottom log of the crib being fastened to the top log of the foundation with bolts.

Training-wall.—Built as wing-dam, except that it only has the aprons on the river side. Foundation and apron built in one crib; 20 feet long and 25 feet wide; the training-wall to have 15 feet base, 5 feet crown, slope 1 on 1 on front and vertical back.

November 17 work was commenced in accordance with the above project, and from that day pushed forward until the 28th day of December. At that date the dam had been completed to the height of 10 feet above the zero plane of the Alexandria gauge, and 60 feet of the training-wall had been completed to within 6 feet of its crest. A crib had also been placed in position and lashed to the more stable portion of the wall, but not ballasted. A sudden rise of 25 feet of water in three days put a stop to construction, and nothing has been done since that date. There remains to be completed the back apron of the dam, 280 feet of the training-wall, and the uncompleted portion of the first 80 feet of the training-wall.

During January and up to the 15th day of February a force of men and teams was employed in quarrying rock and depositing it on the high bank above the Lower Falls. All logs cut were also hauled to the same point. These materials are all ready for quick delivery at the training-wall as soon as the stage of water in the river will warrant the resumption of work.

Sufficient materials are on hand for the completion of dam and training-wall, with

possibly the exception of rock. Caving of the banks has taken place during and since the high water of the last days of December up to date, as follows:

	Feet.
At head of Monroe street, just above wing-dam	2.2
At Madison street, just below wing-dam	32
At St. Anne street	13.8
At Scott street	29
At Elliott street	17
At Fisk street	8
At Beauregard street	15.9

The most of the caving took place previous to the 7th of March, and at Madison and Scott streets. During March some velocity observations were made, which indicated the direction and velocity of currents over the crest of the dam, also in the channel of the river beyond the outer end. At that stage of water there was considerable boiling, due to horizontal and vertical eddies, from just below the dam down to St. Anne street. Until the completion of the Lower Falls Dam it is somewhat uncertain what its exact effect upon the regimen of the river below Bayou Rapides will be. As a result of the observations of the action of the river during the last high-water stage, I would advise that the crib-work of the Madison-street Dam be carried up to the 20-foot level, and a row of close-squared timbers, 12 inches by 12 inches by 40 feet, be set just inside the back of the dam, with wale timbers 12 inches by 6 inches in cross-section, bolted to them by 1-inch machine bolts near their top. Squared timber is proposed, because it will be more exposed than the lower portion of the structure to the alternate action of air and water.

I would also advise that a dam, and training-wall on the same plan as the Madison-street Dam be built out from the head of Elliott street. Ten thousand dollars could profitably be employed in its construction. I would not at present advise the prolongation of the training-wall of the Madison-street Dam; being satisfied that more protection for the same expenditure will result by building a spur-dam at Elliott street.

I take pleasure in stating that the criminal suit brought against me upon information by the ex-district attorney of the twelfth judicial district of the State of Louisiana, which has been pending since October, 1883, was dismissed at the October term of the court, 1884. Throughout all the proceedings the judge has been most fair in passing upon the case; and since the election of Mr. J. C. Wickliffe to the office of district attorney, *all* the officers of the court have been most courteous while carrying out the necessary proceedings under the ill-advised action, to say the least, of the former prosecuting officer.

In closing this report, I would express my appreciation of the energy and loyalty of all those connected with the works of improvement under my charge; foremen and laborers alike deserve credit for their efficiency and industry.

Very respectfully, your obedient servant,

J. W. BEAMAN,
Assistant Engineer.

Capt. ERIC BERGLAND,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

During the fiscal year thirteen steamboats of the Red River and Coast Line navigated the river, drawing from 4 to 9 feet of water, and with capacities ranging from 200 to 900 tons. From September 6, 1884, to October 16, 1884, navigation was suspended.

The above boats averaged nine trips each, and carried the following quantities of freight:

Articles.	Quantities.	Articles.	Quantities.
Cotton.....bales..	56,846	Staves .....number..	127,000
Cotton-seed .....tons..	2,150	Cattle.....head..	1,500
Co ton-seed oil.....barrels..	3,879	Hogs .....do....	500
Hides .....pounds..	129,000	Wood .....cords..	500
Wool .....do....	300,000		

Return freights, 51,540 tons; estimated value, $6,250,000.

Five other steamboats plied in the stream during the year, but the amount of commerce carried by them could not be ascertained.

The commerce of Loggy Bayou, Cane River, and Cypress Bayou is also tributary to this stream.

Shreveport, La., having a population of about 12,000 inhabitants, is the main distributing point for Red River.

The following are the commercial statistics of Shreveport for the past year:

Steamboats running to Shreveport	number..	18
Cotton received at Shreveport	bales..	73,373
Cotton-seed received at Shreveport	tons..	9,150
Refined oil shipped from Shreveport	barrels..	6,750
Soap stock shipped from Shreveport	do....	965
Cotton lint shipped from Shreveport	bales..	425
Cotton-seed meal shipped from Shreveport	sacks..	6,250
Oil cake shipped from Shreveport	do....	28,125
Ashes shipped from Shreveport	bags..	450
Freight shipped to Shreveport	tons..	5,250
Freight shipped from Shreveport	do....	7,850

In addition, large quantities of miscellaneous freight, hides, tallow, &c.

U 2.

SURVEY OF BAYOU PIERRE, LOUISIANA.

The Bayou Pierre region is that part of the Red River Valley lying between the river proper and the pine hills on the west, and reaching from a point 2 miles below Shreveport to Grand Ecore, La. It has a southward extent of 60 and a maximum width of 9 miles.

Red River through this region seems to have very nearly its original course, its present banks being the highest part of the bottom. Its principal changes have probably been several local cut-offs within the first 20 miles and near the end of the reach. As far as Tone's Bayou, 18.7 miles by river below Shreveport, it has an average, slightly diminishing, width of about 400 feet, and a clear low-water depth of at least 12 feet, except at one point. Below, however, its width suddenly lessens to 150 feet, and its depth to 6 feet, the reduction being due to a serious depletion of the stream through Tone's Bayou. This lower river is very tortuous in its course, has a quite uniform channel, and is seriously inadequate for low-water navigation. Its banks are overflowed at the highest stages for about 20 miles below Scopini's Cut-off, and thence down-stream the banks rapidly increase in height.

Bayou Pierre, which probably originated as an outlet of the water forced from its banks by the old raft, removed in 1835–'9, keeps quite closely along the hills on the west, passes through or rather spreads into Lakes Cunnisnia and Pierre, drains Wallace Lake and the pine hills, and restores its water to Red River through Grand Bayou, Bayou Winsey, and its ultimate mouth at Grand Ecore. The upper part of it, about 16 miles, carries no water at the lower stages, forming only a series of long pools with intervals of mud and dry sand, and being closed just above Tone's Bayou to a height of 9 feet above low water. At high stages, however, it draws through its head, Sand Beach Bayou, and a new break in old Lattier Bend a considerable volume of water from the river.

Tone's Bayou was originally a drain cut about 1850 by J. B. Gilmer between Red River and Bayou Pierre. This rapidly increased and in 1857 was regarded by the State engineers as threatening a total di-

version of the main stream. The first effort to close it was made as auxiliary to the opening of Scopini's Cut-off by the Confederate Government in 1863. The dam then constructed, however, was quickly destroyed, and the ultimate effect of the divers military operations thereabout was an increase of the outlet. The closure has subsequently been attempted, once by the State and frequently by the United States, but as yet unsuccessfully and without any permanent effect.

The various attempts made by the United States are noted in the report on the improvement of Red River. The only check to the total change of the river course threatened has resulted from the formation of the raft in Bayou Pierre, which at low stages acts as a dam. Tone's Bayou now carries off at low water about one-fourth and at high water about three-fourths of the water of the river, and with Bayou Pierre below and Bayou Winsey forms the stream which it is proposed to open as a new route for navigation.

The first obstacle to be overcome in realizing this project is the raft in Bayou Pierre, which extends 5.3 miles above and 2.8 miles below Red Bluff, at the mouth of Wallace Lake. The upper portion is fragmentary, of recent formation and loose structure, occupying in the aggregate about one-fifth of the area of water surface. That below is more nearly continuous and gradually becomes denser until at its lower end it is solidified, turning all the water into a tangle of small streams on the east and Bennett's Bayou on the west, whence the greater part of it is recollected in the original channel below and thence gradually spread into Lake Cunnisnia. The next notable obstruction is the flat clay bar forming the bottom of the lower half of Lake Cunnisnia. This is from 15 to 20 feet above a line of uniform slope through the proposed route, the discrepancy being made up in rapids below Lake Pierre. There is a good channel from Le Coup, at the foot of Lake Cunnisnia, for 7½ miles to Round Lake, a small body of open water in the midst of Lake Pierre, which is otherwise merely a cypress brake without any distinct channel. At least 2 miles of this would need to be penetrated in the proposed improvement.

Just below Lake Pierre there were at the date of the last examination rapids which I am informed are now receding into the lake. Grand or Boggy Bayou leaving Bayou Pierre 1½ miles below Lake Pierre and reaching Red River within 2½ miles, seems to have become the principal channel of restoration to Red River, its discharge, I am told, having increased remarkably of late.

For the next 12 or 15 miles below Grand Bayou, Bayou Pierre has numerous rapids over bars of hard, insoluble clay, those furthest up stream being somewhat rocky. Its average width is about 140 feet and its low-water depth between rapids about 15 feet. The snags in this part according to the report of Mr. Wilson in 1879, average about 54 to the mile. Below this for 6 miles through Bayou Winsey to Red River there is a deep and unobstructed channel.

Mr. Wilson reported that Bayou Pierre for 2 miles below Bayou Winsey was closed to a height of 13½ feet above low water; that thence there was for 3 miles a good channel; that thence for 16 miles to Spanish Lake was made almost impassable by snags and cypress knees; and that from Spanish Lake to Red River there was an open channel. The streams described below carry water only at high stages.

Sand Beach Bayou virtually leaves Red River at Shreve's Cut-off, 6 miles below Shreveport, and enters Bayou Pierre 3 miles above Tone's Bayou; Bayou Chicot leaves Bayou Pierre on the right, 1½ miles below

Tone's Bayou, and returns 3 miles lower down, with a small issue between, into Wallace's Lake.

Pascagoula Bayou traverses the bottom from Red River, 12½ miles below Scopini's Cut-off, to Bayou Pierre, 3 miles above Red Bluff. It is completely closed by two levees crossing.

Prairie River, crossing Pascagoula Bayou between these levees, and draining the low lands near Bayou Pierre above, runs between Red River and Lake Cunnisnia with an issue into Bayou Pierre at Le Coup, and crossing Bayou La Chute near Bayou Pierre, passes parallel with the latter below into Lake Pierre.

Bayou La Chute crosses from Red River to Bayou Pierre, near the foot of Lake Cunnisnia. At high water it drains both ways, but principally into Bayou Pierre.

Cross Bayou and Murrell's Cut are outlets from Lake Pierre to Red River.

The land between Bayou Pierre and Red River is regarded as very fertile. Only the high ground just along the river, however, is cultivated. Probably less than one-fourth of it is now available for tillage, the rest being subject to overflow and heavily timbered.

The proper improvement of Red River from Tone's Bayou to Grand Ecore has long been a mooted question. The Government has hitherto undertaken to maintain the river route proper by damming up Tone's Bayou. This has been deemed most advisable by the State engineers of Louisiana, and by the United States engineer officers in charge of the work. The execution of this project has met with considerable opposition from planters and others in the vicinity. Those along the front, or on Red River proper, seem to think that the damming of Tone's Bayou would cause the overflow of their lands, while those living on the back channel, or Bayou Pierre, desire to have the latter cleaned out and otherwise improved, and made the main steamboat channel from the head of Tone's Bayou to Bayou Winsey or Grand Ecore. This opposition appears to have become more apparent in late years, for in 1874 Capt. William Robson was deputed by the Shreveport Board of Trade to represent to the Secretary of War the importance of closing Tone's Bayou, and in 1877 citizens of New Orleans and others interested in the navigation of Red River subscribed $3,000 to help repair the dam across the bayou.

The relative advantages of the two routes are discussed at length by Major Howell in Annual Report of Chief of Engineers for 1873, page 628, and by Major Benyaurd in Annual Report for 1882, page 1539. In the latter part of 1878 an examination was made of Tone's Bayou, Bayou Pierre, and connecting lakes and bayous to Bayou Winsey, in order to ascertain the cost of opening up this route to navigation; this was estimated at $174,404, including the cost of removing the raft in Bayou Pierre, which was estimated at $75,000. In the spring of 1883 another examination of this region was made, and the estimate for making a navigable channel from mouth of Bayou Winsey to the entrance of Tone's Bayou given at $250,125, and for the removal of the raft alone $100,000. The report on this examination recommended an accurate survey of the Bayou Pierre region at an estimated cost of $8,646. This was based on a detailed estimate submitted to the Department December 20, 1882, in which it was assumed that the field-work could be completed in three months.

In order to obtain all the data necessary for a complete discussion of the questions involved, it was considered necessary to include in the survey all the water-ways or bayous lying between Bayou Pierre proper

and Red River, from the head of Bayou Pierre to Bayou Winsey, and also Red River between these points. The actual field-work of the survey was commenced October 22, 1884, and discontinued January 20, 1885, on account of high water. Mr. Hart Vance, assistant engineer, who has had long experience on the Missouri River and other Government surveys, was placed in charge of the work. His report is submitted herewith, and attention invited to it for the details and extent of the survey and office work. He also calls attention to certain significant data that have been developed by the survey of last season, which will have an important bearing on the final determination as to the proper method of improvement, and discusses the changes that have taken place since the time of the previous examinations.

Several unforeseen circumstances have combined to make the cost of the survey exceed the original estimates, among which may be mentioned the following:

Owing to the lateness of the season when I assumed charge of the work, the organization of the party was so hurried that it was impracticable to obtain, in all cases, assistants of experience or assured competency, and consequently some of the early work was valueless, and had to be repeated after reorganizing the party.

Failures in the timely delivery of necessary outfit retarded the commencement of the work, after nearly all the expenses of a full party had been assumed.

Again, nearly three-fourths of the last month in the field was lost on account of rains, storms, and floods; not more than one full week's work having been done from December 23 to January 21.

The interruption of the field-work, its suspension owing to high water, and its resumption after a lapse of over a year, will necessarily occasion a greater expense than if it had been completed without interruption.

As the survey is incomplete, no estimate can now be submitted of the cost of opening the Bayou Pierre route to navigation. With the small balance now available, field-work cannot be resumed during the coming low-water season.

It is, however, of great importance that the survey be completed as contemplated, in order that the question of cost and advisability of opening the Bayou Pierre route may be definitely settled.

The cost of completing the survey to Bayou Winsey is estimated at $5,000. As this survey includes a portion of Red River, the estimate for the survey of the latter may be somewhat reduced, as indicated in my report on improvement of Red River.

The following drawings are sent herewith:

PLATE I.—Map of Tone's Bayou and vicinity, intended to illustrate the relative dimensions of Red River above and below Scopini's Cut-off, and of Tone's Bayou.

PLATE II.—Reduced map of completed survey on nearly same scale as Plate III.

PLATE III.—Sketch of the entire Bayou Pierre region, made up from information gained by previous examinations. This shows the extent of the completed survey and what remains to be surveyed.

Money statement.

Amount appropriated by act approved July 5, 1884	$8,600 00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	7,936 15
July 1, 1885, amount available	663 85
Amount (estimated) required for completion of existing project	5,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	5,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

DAM-SITES.

a. Hotchkiss Dam , 1868.
b, Confederate - , 1868.
c, Allen - -
d, Woodruff - 1872.
e, Bergnaud - 1877.
f, " 1881.
g " 1881.

Section "A" is 10000 ft above Scopini's Cut Off.

SCOPINI'S CUT-OFF

RED RIVER

COTTON

LUDDER

CREEK

TONES BAYOU

BAYOU PIERRE

BAYOU PIERRE

UPPER RED RIVER

H.W.

A

L.W.

LOWER RED RIVER

H.W.

B

L.W.

OLD RIVER

H.W.

C

L.W.

RED RIVER

LONG BRANCH LANDING

MAP

OF

TONES BAYOU AND VICINITY

LOUISIANA,

SURVEYED BY

ASST. ENGR HART VANCE

NOVEMBER 1884.

Stage +

To accompany Annual Report to the Chief of Engineers for the year ending June 30, 1885.

Eric Bergland

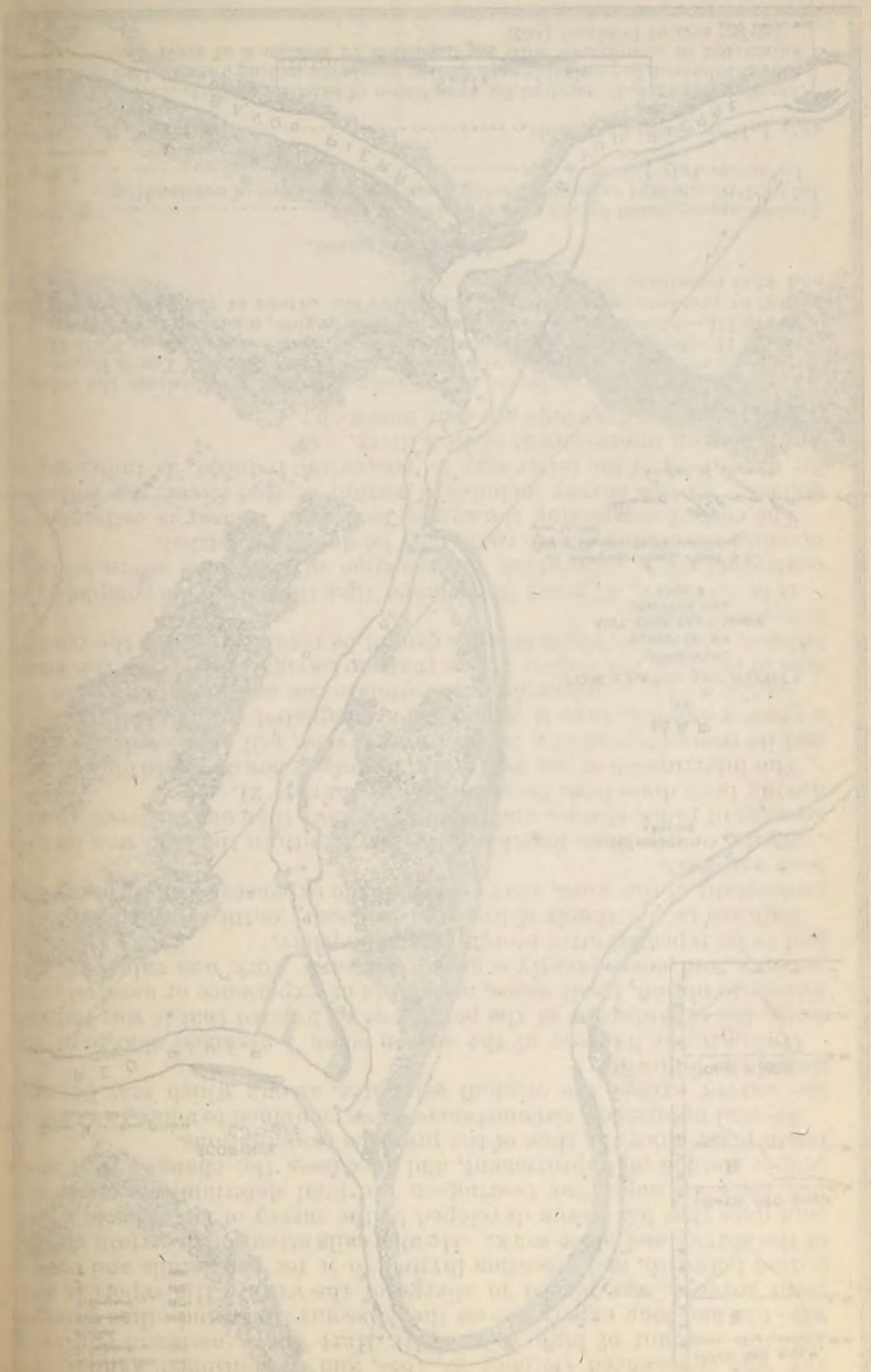
Captain of Engineers.

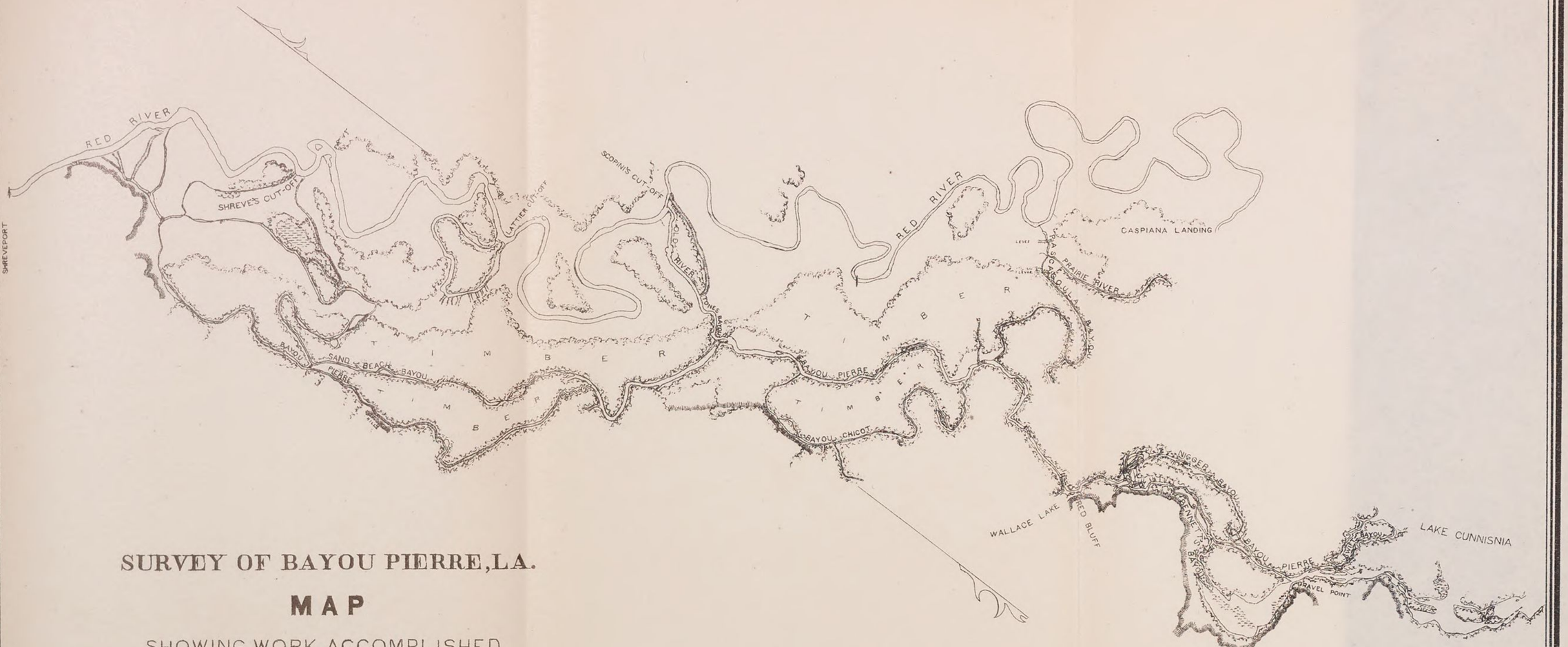
Scale.

5000 feet.

HART VANCE, DEL.

H Ex1 pt2. v2 491





SURVEY OF BAYOU PIERRE, LA.

MAP

SHOWING WORK ACCOMPLISHED

IN

1884

To accompany Annual Report to the Chief of Engineers,
for the year ending June 30, 1885.

Eric Bergland
Captain of Engineers.

H Ex1 pt2 v2 49 1

SKETCH OF

RED RIVER AND BAYOU PIERRE REGION

FROM SHREVEPORT TO COUSHATTA

LOUISIANA

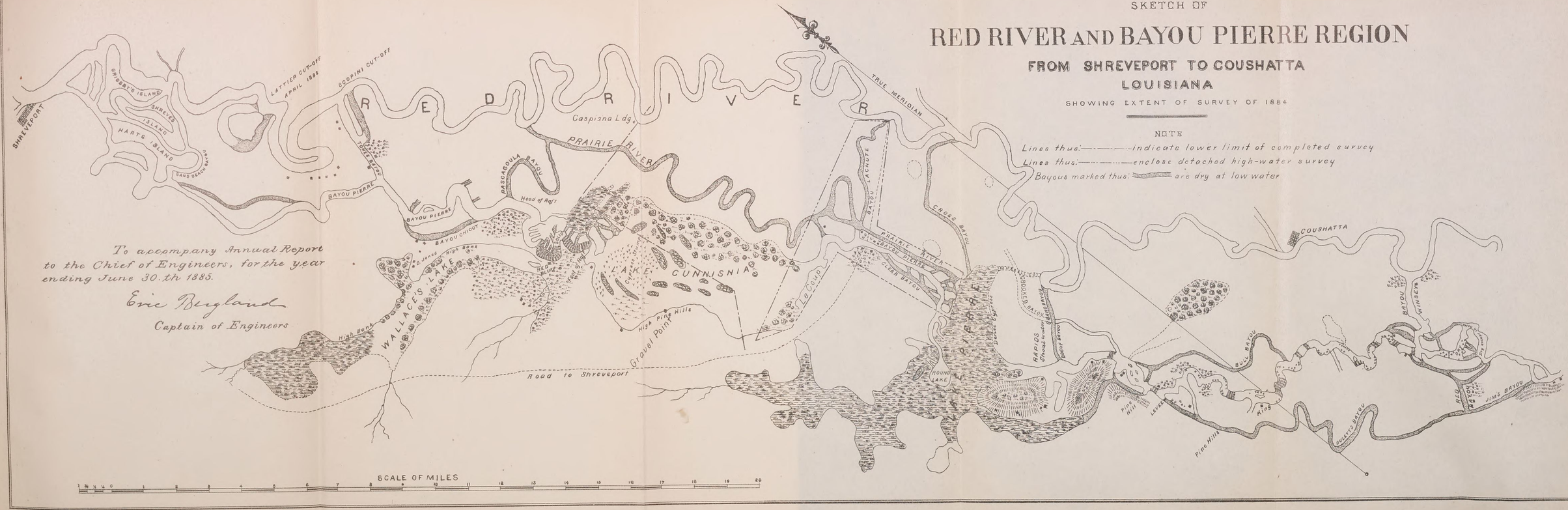
SHOWING EXTENT OF SURVEY OF 1884

NOTE

Lines thus:———————indicate lower limit of completed survey

Lines thus:———————enclose detached high-water survey

Bayous marked thus:═══ are dry at low water



To accompany Annual Report to the Chief of Engineers, for the year ending June 30.th 1885.

Eric Bergland

Captain of Engineers

H Ex1 pt2 v2 49 1

REPORT OF MR. HART VANCE, ASSISTANT ENGINEER.

VICKSBURG, MISS., *June* 30, 1885.

SIR: In accordance with your directions of the 23d instant, I respectfully submit the following report of the survey of Bayou Pierre, Louisiana. The actual field-work of the survey was commenced October 22, 1884, and discontinued January 20, 1885. There was a serious loss of time at first, because of the inexperience of some of my assistants; and fully three-quarters of the last month were unavailable on account of prolonged rains and a consequent flood, which ultimately necessitated suspension. The accompanying sketches show the extent of the work accomplished. This comprises a survey of Red River from Shreveport, 18.75 miles above Tone's Bayou, to Caspiana Landing, 25.19 miles below, affording an accurate representation of the channel contours and of all adjacent topography. Surveys of Bayou Pierre and all bayous between that and Red River from Shreveport to Tone's Bayou. Surveys of Tone's Bayou, Bayou Pierre through the raft region, the numerous side issues and small channels into which the water is driven by the raft, and the western part of Lake Cunnisnia to a point about 2 miles above Le Coup. Surveys of Pascagoula Bayou and of Prairie River as far as Caspiana Landing. A detached survey of Bayou La Chute and the various channels between lakes Cunnisnia and Pierre; an examination of Le Coup Bar; divers transit and chain lines for checks, location of levels, &c., along Red River and between Red River and Bayou Pierre, and observations for discharge in Red River above Tone's Bayou and in Tone's Bayou. The survey included a system of perfectly checked levels along Red River, Tone's Bayou, and Bayou Pierre, and over three lines between Red River and Bayou Pierre, with frequent observations of water-level and bank and high-water elevations.

In the hydrographical work there were several unforeseen deficiencies. Gauges were kept at Shreveport, Cotton Point, Bayou Winsey, and the site of camp, but it is found that there was need of such also at the head and at the foot of the rafts in Bayou Pierre, there being no such correspondence in the variations of stage at these respective points as will make the requisite corrections of level calculable from the information obtained. It is desirable, too, that determinations of discharge in Tone's Bayou and in Red River, above and below its separation, should have been made at various stages, the ratios between the factors of discharge in the three channels being markedly variable. It would likewise have been well to make a thorough examination of the bottom at several points. For neither of these works were means available.

The surveys of Red River and the various bayous on the west above Tone's Bayou were deemed relevant, if not requisite, to the object contemplated, as showing the likelihood of the influx to be governed in any projected improvement, and those of Red River and the intermediate channels below, as affording the means of comparison to determine the question of advisability. For instance, in illustration of the necessity for the upper work, it was ascertained that a great volume of the flood-water rushes unchecked through both openings into "Old River" at Lattier Cut-off, and the two currents thus formed, meeting at the head of the bend and forced to find or make a new outlet, have made it through the woods to Sand Beach Bayou and Bayou Pierre, an incipient parallel to Tone's Bayou being the result. The possibility of any serious diversion of the water supply here (and I understand that such possibility has been developed into a probability by the last high water) has an obvious bearing on all questions of improvement below. Germane to this matter, and almost equally important, as indicating a chance of relief from the danger cited, is the revelation by the map of a likelihood that the main river may soon cut into this "Old River" a mile above its mouth and reverse the currents that now threaten such damage. The value of the collateral work below will, I think, become manifest upon examining the information obtained. Until February 13 Assistants F. S. Burrowes, Howard Vance, G. N. Marshall, and D. B. Dunn were retained in the office and engaged in digesting the field notes. Since that date only the first named has assisted me. All the work done, except the detached part between the two lakes, has been mapped on a scale of $\frac{1}{6000}$, making four sheets 10 feet by 42 inches; cross-sections of all of Red River surveyed, and of Tone's Bayou and Bayou Pierre to the head of the raft, have been developed, and comparative profiles of high water, low water, bank, and channel bottom elevations are in process of construction. About one-fourth of the ink-work on these sheets has been done. A reduced copy of the map will be ultimately required. The significant data for a consideration and determination of the remedial measures needed, which have thus far been developed by the survey, are set forth below.

At a 0.12 stage Red River above Tone's Bayou has a discharge of 2,629 cubic feet per second, with a sectional area of 4,315 square feet; Tone's Bayou, a discharge of 799 cubic feet per second, with a sectional area of 2,137 square feet; and Red River below Tone's Bayou, a discharge of 1,830 cubic feet per second, with a sectional area of 1,000 square feet. Red River from Shreveport to Tone's Bayou has a uniform low-water slope of 0.057 foot per mile, and a uniform high-water slope of 0.643 foot per

mile, the oscillation at Shreveport being 33.65 feet, and that of Tone's Bayou 22.66 feet. Red River between Tone's Bayou and Pascagoula Bayou, 12.73 miles below, has, at low water, a slope of 0.475 foot per mile, and at high water a slope of 0.471 foot per mile. Tone's Bayou, 2.46 miles, has high and low water slopes respectively of 0.015 foot and 0.543 foot per mile. Those of Bayou Pierre, from Tone's Bayou to the beginning of loosely-formed raft, 3.22 miles, are 0.075 foot, and 1.181 feet; thence to Pascagoula Bayou, 1.61 miles, through fragmentary raft, 0.071 foot and 0.521 foot; and thence to a point at which all the water has been diverted from the original channel by the solidified raft, 4.89 miles, through broken rafts gradually growing denser down-stream, 1.109 feet and 1.072 feet. As intimated above, the difference in water-level at the head and at the foot of the raft is not a constant for any one of the lower stages. The progress of a change through the rafts is very slow, and frequently Lake Cunnisnia rises from the contributions of the westward pine-hills and subsides again before the corresponding rise from above has reached it. The high-water slope from the head of the solidified raft to Gravel Point, 2.56 miles, is 0.588 foot per mile. From Gravel Point to Le Coup, the extent of Bayou Pierre's passage through Lake Cunnisnia, about 6.25 miles, there is almost constantly a fall of 2.5 feet. The total length of Bayou Pierre, closed with jams, is 8.14 miles. As far as Red Bluff, 5.30 miles, these jams are recent, superficial, and of loose structure, with long spaces of open water between. Thence the raft becomes denser and is overgrown with weeds, saplings, &c., forcing the water through numerous small outlets. For the last mile it is almost completely solidified and overgrown with timber, all the water being driven into Nigger Bayou on the east and Bennett's Bayou on the west. The latter stream rejoins Bayou Pierre at the foot of the raft, and the former half a mile further down, each, however, losing some of its volume through issues into the northwestern and northeastern arms of Lake Cunnisnia. Bayou Pierre strikes the pine-hills again at Gravel Point, and thence is gradually dispersed into Lake Cunnisnia, there being no distinct channel through the lower half of this water-bed.

The lowest point of a cross-section at Le Coup, 21 miles below Scopini's Cut-off, is 12 feet above the bottom of Red River, the same distance below that point, and almost as much above *low water* in Red River at Cotton Point, just opposite. In the Bayou La Chute region high water from the lake stands, near Red River, 8 feet above that in the river and within 1 foot of the height of its banks. At the foot of Lake Cunnisnia the bank on the left approaches the hills on the right, forming a capacious channel to Lake Pierre. These data and comparisons with the results of previous examinations show that the process of change in Tone's Bayou and Red River, above and below, has been somewhat peculiar. There has evidently been a constant and quite rapid diminution of cross-section in Little River (as Red River below Scopini's is called), and yet a uniformity of channel, remarkable in a case of such rapid change, has been preserved. The ratio between the discharges through the two outlets is apparently reversed at low and high water, Tone's Bayou, at a maximum stage, discharging almost three times as much as Little River, and at a minimum about one-third as much. This is, of course, due to the raft in Bayou Pierre, the effect of which as a dam gradually decreases from its maximum at low water until a stage is reached at which the flood can pass freely above the jams into the wide receptacle of the lake. A comparatively equable current is thus preserved in Little River, and its regularity of channel is the result.

Lieutenant Woodruff, in 1873 (Report of the Secretary of War, 1873, Part II, page 673), stated that "the slope of the main river was materially diminished in passing Tone's Bayou." The low-water slope of Red River above Tone's Bayou is now less than one-eighth as much as that below. This change has evidently been produced by an increase of absolute height in the bed, and thence in the water surface of Little River, the profile showing that for 3 miles below the cut-off the river bottom is 6 feet higher than the highest points of that above. A marked increase in the wet section in the upper river is corroborative evidence on this subject. Indeed, this part of the river has just the character of a stream above a dam. The damming process in Bayou Pierre, however, at least as far as the head of Nigger Bayou, is attributable entirely to the jams, the channel, independent of these, being in good shape. It is easily seen that the difficulties of any method of improvement are constantly increasing. If the raft in Bayou Pierre were removed there would, at least, be no trouble in getting the full water supply into the new channel. One of the earliest consequences would be the closure, to navigation at any rate, of Little River. This fact and the necessity, perhaps, of providing an outlet for the débris of the raft would make it advisable to work from below in opening the bayou. Through the lower half of Lake Cunnisnia and, if I be correctly informed, through the whole length of Lake Pierre, it would be necessary to construct an entirely artificial channel. The oscillation in any navigable channel being not less than 21 feet, this would require a depth of at least 26. In addition to the removal of the raft above the capacity of Bennett's Bayou for 2 miles would need to be materially increased and the innumerable outlets on the left to be closed. Indeed, a virtually continuous levee 3 feet to 12 feet in height would

have to be built, at least on one side, from Pascagoula Bayou to Le Coup, 14 miles, and probably on both sides through Lake Pierre. This is upon the assumption, too, that through the lower part of Lake Cunnisnia a channel would be dredged to the normal slope, that is, to 15 or 20 feet below the present bottom. The contemplated water route might be eventually opened at much less cost than in this way, if incipient channels were dredged through Lakes Cunnisnia and Pierre to Grand Bayou, the raft removed into the adjacent parts of Lake Cunnisnia, and the river left to work out its own channel. This, however, would be followed very soon by the closure of Little River and so result in an indefinite suspension of low-water navigation, even the ultimate concentration of the stream through the lakes being doubtful. On the other hand, if Tone's Bayou be closed, the first important consequence will be, of course, an unprecedented overflow along Little River. In this case, however, the uniform channel giving definite and constant direction to the current will insure the most effectual application of the increased scouring force and thus a maximum rate of reduction to normal slope and succinct flood limits. Dredging away the deposit, 3 miles long, below Scopini's Cut-off would materially accelerate this effect. The completion of the survey as projected will involve surveys of Red River 48 miles; Bayou Pierre, 16 miles; Prairie River, 10 miles; Grand Bayou, 2.5 miles; Cross Bayou, 6 miles; Bayou Winsey, 2.5 miles; possibly several other collateral courses, Lake Pierre, and, practically, half of Lake Cunnisnia.

Some rerunning of the work done in January may be required for details hidden by the overflow; a special examination of the incipient cut-off through Old Lattier Bend should be made; and it would be well to get the additional hydrographical information to which I have already referred.

With an experienced party and all favorable conditions this completion, except in the last particular, could be effected within a month. Under probable conditions, however, it will require six weeks.

The probable cost, therefore, will be as follows:

Organization and reaching and quitting work	$500
Field work, one and one-half months	2,250
Mapping	750
Additional hydrographical work, &c	500
Contingencies	200
	4,200

This, I think, will be the minimum for which the work can be well done.

Very respectfully, your obedient servant,

HART VANCE,
Assistant Engineer.

Capt. ERIC BERGLAND,
Corps of Engineers, U. S. A.

U 3.

IMPROVEMENT OF CYPRESS BAYOU, TEXAS AND LOUISIANA.

The improvement of Cypress Bayou included the whole navigable route from Shreveport, La., to Jefferson, Tex., via Sodo and Fairy lakes and Cypress Bayou. An examination was made by the United States in 1872, and the work of improvement was begun the same year and completed in 1880, a well-defined channel marked with sign boards, from Shreveport to Jefferson, a distance of 65 miles, being the result of the work. Since then the leaning timber has grown again.

In July, 1884, a steamer was chartered and employed during the month in removing the following obstructions, viz:

Snags pulled	60
Rods of willows cut	625
Trees cut	335
Projecting limbs cut	54
Feet of sand-bars washed out	315

In his annual report for 1874 Major Howell submitted a project for construction of a dam across the lake at Albany Point and for making

a cut through to Red River, at an estimated cost of $372,580, which would give a navigable water to Shreveport nearly all the year. It was recommended that this amount be made available in one appropriation for successful execution of the work. No appropriation has been made under this project.

By direction of the Chief of Engineers an examination of the bayou was made in July, 1883, and the report thereon was sent to the Department August 1, 1884, by Major Miller.

The river and harbor act of July 5, 1884, directed a resurvey of the work, to ascertain if the necessary improvement could not be made upon some other plan than that proposed by Major Howell. An examination was made with the small balance available, and the report thereon submitted January 5, 1885. On account of the decreased commerce of the stream, the building of railroads having furnished more convenient outlets for a large quantity of shipments, and the great cost of the cut and dam across Albany Flats, it was recommended that the improvement be confined to straightening and marking the present channel, cutting stumps, and reopening cuts by dredging at an estimated cost of $16,000, which it is believed will secure safe navigation between Jefferson, Tex., and Shreveport, La., for seven or eight months each year. As the obstructions to be removed increase in number and magnitude yearly, and the cost of repairing the dredge-boat will probably be greater than that given in the estimate referred to, it is recommended that the estimate be increased to $18,000, and that the whole amount be made available in one appropriation.

The former appropriations are as follows:

By act approved June 10, 1872	$10,000 00
By act approved March 3, 1873	50,000 00
By act approved August 14, 1876	13,000 00
By act approved June 18, 1878	15,000 00
By act approved March 3, 1879	6,000 00
Amount expended to June 30, 1885	93,968 85

With the amount asked for the fiscal year ending June 30, 1887, it is proposed to repair the dredge-boat belonging to this work, and carry out the improvement as recommended in my report of January 5, 1885.

Money statement.

July 1, 1884, amount available	$806 49
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	775 34
July 1, 1885, amount available	31 15
Amount (estimated) required for completion of existing project	18,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	18,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

One steamboat of 125 tons burden, and drawing 4 feet of water, navigated Cypress Bayou and the lakes during the last fiscal year, from December until May, making twenty trips and carrying the following freights:

Cotton	bales.	5,000
Cotton-seed	sacks.	7,000

with return freights of Western produce and miscellaneous supplies, the value of which could not be ascertained.

All the cotton received at Jefferson, Tex., was shipped by rail.

U 4.

IMPROVEMENT OF CANE RIVER, LOUISIANA.

Cane River is an arm of Red River, about 70 miles in length from its upper end, 2 miles below Grand Ecore, where it leaves Red River, to Colfax, La., where it again joins that stream. It formerly was part of Red River, but in 1849, a cut-off turned the river into its present bed, and Cane River has gradually filled up until at present it is nearly dry for six months in the year. About half way between Natchitoches and the head of the stream, a distance of 4 miles from either point, a gravel bar about 200 yards long stretches entirely across the river. At a low stage the water below this bar flows towards the mouth, while above it flows towards the head of the stream. Just above the bar there is a sharp bend in the river, and the distance across to Red River is not more than 1,000 feet. The bank of Red River at this point is caving rapidly, and should this continue with the same rapidity during the next five years as in the past five the two rivers will meet. An examination was made by the United States in December, 1882, and the obstructions to high-water navigation were found to be snags, logs, stumps, caved-in and leaning trees, and some rock. No estimate of cost of improvement was submitted by the United States engineer officer in charge, but his assistant estimated the cost of removing the obstructions at $7,665.

The first appropriation ($2,500) was made by river and harbor act approved July 5, 1884, and the project for its expenditure contemplated the removal of the obstructions as far as practicable with this amount.

The work was commenced by Capt. J. T. Dorey, of the United States steamer Florence, in the lower portion of the river, October 21, 1884. Mr. Joseph Spotten, a pilot of this stream, was placed in local charge of the party, and the work was continued under his superintendence until December 10, 1884, extending from the mouth to the head of the river. The following obstructions were removed:

Shore snags cut	1,783
Leaning trees cut	4,071
Stumps cut	446
Channel snags cut	721
Rods of willow-brush cut	4,810
Cubic yards of rock blasted	1,250

This work resulted in freeing the channel, to a great extent, of obstructions, increased the depth of water during the navigable season, and enabled steamboats to make quicker trips. During the past year navigation was good from December till May, inclusive.

Some obstructions yet remain, the removal of which would lessen the danger of navigation, and some new obstructions are formed yearly, but not to such an extent as on other rivers in this locality, as the banks of the stream are high, and for about 50 miles are covered with Bermuda grass, and therefore not subject to abrasion; the other 20 miles is covered with a heavy growth of timber, and the banks are continually caving and sliding.

This stream being an arm or high-water channel of Red River, it is recommended that appropriations for future improvement be included in that for the main stream, in which case necessary work can be done when and where the interests of navigation require it. No specific amount is therefore asked for the separate improvement of this stream.

Money statement.

Amount appropriated by act approved July 5, 1884	$2,500 00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	2,350 31
July 1, 1885, amount available	149 69

COMMERCIAL STATISTICS.

During the fiscal year three Red River steamboats, drawing from 8 to 9 feet of water, and with capacities of from 800 to 900 tons each, made twenty-five trips up the stream from the mouth to Natchitoches, the head of navigation, from December to May, inclusive, carrying the following freights:

Cotton	bales..	5,000
Cotton-seed	sacks..	45,000

Return freights (6,000 tons) estimated value $100,000.

U 5.

IMPROVEMENT OF LOGGY BAYOU, LAKE BISTENAU, AND THE DORCHEAT, LOUISIANA.

Dorcheat Bayou rises in Hempstead County, Arkansas, flows in a southerly direction into Lake Bistenau, which empties through Loggy Bayou into the Red River, about 110 miles below Shreveport, La.

An examination of the system was made by the United States in December, 1882, when it was found to be obstructed with logs, stumps, leaning trees, brush, &c., and that it was navigable at high water as far up as Murrell's Point, on the Dorcheat, near Minden, La., and about 70 miles above the mouth of Loggy Bayou, for about five months in the year. No estimate of cost of improvement was submitted by the United States engineer officer in charge, but his assistant, who made the examination, estimates the cost of removing the obstructions, building dams, and dredging where necessary in order to increase the period of navigation two months, at $19,338.

The first appropriation ($5,000) was made by river and harbor act approved July 5, 1884, and the project for its expenditure contemplated the removal of the most serious obstructions to high-water navigation. A party was fitted out and work begun September 25, 1884, and continued under the superintendence of Mr. George Alban, until December 8, 1884. This work extended over the navigable portion of the lake and bayous, *i. e.*, from Murrell's Point, on the Dorcheat, to the mouth of Loggy Bayou, and the following obstructions were removed, viz:

Snags removed from channel	134
Logs removed from channel	470
Stumps removed from channel	4,575
Leaning trees cut	1,690
Yards of willows and brush, varying in width from 12 to 250 feet, removed from the channel and banks	36,553

Eighty sign-boards were set up in the lake to indicate the cleared channel.

The removal of these obstructions has greatly benefited navigation, and the superintendent states that the navigable depth was in many

places increased fully 3 feet. Boats were enabled to run to the head of navigation during six months of the past fiscal year.

The improvement, like that of all streams in this part of the country, is not permanent, and even if the streams were entirely cleared of obstructions one season new ones would constantly be added, caused by sliding and caving banks, which would require removal from time to time.

These streams are now in fairly good condition for high-water navigation, which lasts about six months during the year. To lengthen the navigable season, dredging of bars and narrow places occasioned by slides would be necessary. It is doubtful whether the demands of commerce would justify the great expenditure necessary for such improvement. Minden, which is the principal shipping point, now sends much, if not most, of the cotton from the surrounding parishes to market by the Vicksburg, Shreveport and Pacific Railroad, consequently the importance of the water outlet has somewhat diminished, although it is still a convenient and necessary avenue for the commerce of the country on the east side of Lake Bistenau and Loggy Bayou.

The amount available for this improvement is too small to attempt any work during the next fiscal year. After the expiration of this time new obstructions to high-water navigation will require removal, and it is proposed to use the amount asked for the fiscal year ending June 30, 1887, for that purpose.

Money statement.

Amount appropriated by act approved July 5, 1884	$5,000 00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	4,568 21
July 1, 1885, amount available	431 79
Amount that can be profitablyexpended in fiscal year ending June 30,1887 Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	5,000 00

COMMERCIAL STATISTICS.

Two steamboats, drawing 4 feet of water and of 200 tons capacity each, navigated these streams during the past fiscal year from December to May, inclusive, ascending to Murrell's Point, making twelve trips each, and carrying the following freight:

Cotton	bales..	11,000
Cotton-seed	sacks..	5,000

A large amount of up-freights were also carried, the value or quantity of which could not be ascertained.

U 6.

IMPROVEMENT OF OUACHITA AND BLACK RIVERS, ARKANSAS AND LOUISIANA.

The Ouachita River has its headwaters in the Ouachita Mountains, Polk County, Arkansas, and, following an irregular course, flows in a general southeasterly direction through Arkansas and Louisiana, until being joined by the Tensas and Little rivers at Trinity, La., these form the Black River, which, flowing in a southerly direction, enters the Red River near its mouth. The entire length of the Ouachita is about 500 miles—Black River is 75 miles long. An examination of the

Ouachita River from Rockport, Ark., to the Louisiana line was made in 1870. That portion from Rockport to Arkadelphia, Ark. (45 miles), was found to be little more than a mountain torrent, and was not considered worthy of improvement. The cost of removing obstructions and dredging between Arkadelphia and the Louisiana line, based upon this examination, was estimated at $72,300. An estimate was also submitted at the same time for that portion of the river from the Louisiana line to its mouth, no examination of this part of the stream having then been made, giving the probable cost of improvement as $26,000, or a total estimated cost of improvement from Arkadelphia, Ark., to to the mouth of $98,300.

A survey of the Ouachita River from Trinity, La., to Camden, Ark., was made in 1871–'72. The report on this survey recommended the building of five locks at an estimated cost of $1,163,083.75, which were to give not less than 4 feet of water in the river at all times.

A resurvey from Camden, Ark., to Trinity, La. (294 miles), was made in 1873–'74, to determine more definitely certain questionable points connected with the contemplated improvement by locks, but in view of the great cost of the work and its doubtful utility, the above project was abandoned.

An examination of the river from Arkadelphia to Camden, Ark., was made in December, 1882, and it was recommended that no work be performed between those places. The present project contemplates the removal of obstructions to navigation, consisting of wrecks, logs, snags, leaning timber, &c., and the improvement of shoal places. No estimate of the cost of this improvement can be submitted, as the obstructions are continually forming and require removal from time to time.

By river and harbor act of July 5, 1884, the Black River, Louisiana, was added under the same head of appropriation with the Ouachita, this river being the connecting link between the Ouachita and Red rivers, and requires the same character of improvement. Work was begun in 1871, and has consisted principally in the removal of logs, snags, leaning trees, and similar obstructions to navigation. It has been carried on ever since when funds were available. In 1875 the snag-boat O. G. Wagner was purchased and fitted up and has operated successfully in the river since that time. Under the project for locks and dams, lumber was purchased for the foundations, at a cost of $20,708.52; but after this project was abandoned the lumber was sold at public auction and the proceeds turned into the Treasury.

The work heretofore done has greatly benefited navigation by the removal of obstructions, and some of the shoal places have been increased in depth from 12 inches to over 3 feet at low water. Previous to any work of improvement large boats plied between New Orleans and Camden about half the year. These boats now run to Camden from seven to eight months in the year, and smaller boats run to Monroe, La., during the entire year.

During the latter part of August, 1884, the United States snag-boat O. G. Wagner was fitted out at Memphis, Tenn., and proceeded at once to the Ouachita River, entered the Black River September 12, 1884, and continued work in the two streams until early in January, 1885, when operations were suspended on account of extreme high water, and the boat was laid up at New Orleans to undergo repairs necessary before returning to the work.

The report of Capt. P. C. Montgomery, commanding the Wagner, is submitted herewith.

The following obstructions were removed:

Snags pulled	677
Stumps removed from channel	118
Shore snags cut	2,264
Logs removed from channel	267
Petrified logs removed from channel	2
Cylinders (wreck of steamer) removed from channel	1
Trees cut	7

The greater portion of this work was performed between Monroe, La., and the mouth of Black River, and was of great benefit to navigation, as no work had been done in the river since 1882, and many formidable obstructions had formed in that time. In many places landslides had occurred, some of them extending entirely across the river, greatly obstructing the channel. These were all removed, as were a great many other channel obstructions. Steamboat men navigating the river have expressed the greatest satisfaction at the work of the past season.

The appropriation of July 5, 1884, included the removal of wrecks obstructing the harbor of Monroe, La. These wrecks were two old wharfboats, the Memphis and Kilgore, and a small force, under the superintendence of Mr. R. H. Endom, commenced their removal September 25, 1884, and completed the work November 10, 1884. The old material recovered from the wrecks was taken to New Orleans on the Wagner, and there sold at public auction February 14, 1885, and the proceeds of the sale turned into the Treasury.

The balance available will be needed for the care and preservation of the property pertaining to this improvement during the next year, or until further funds are available; hence the work cannot be resumed until another appropriation is made for continuing the improvement.

With the amount asked for the fiscal year ending June 30, 1887, it is proposed to continue the improvement of the river as heretofore, *i. e.*, building and repairing wing-dams where necessary, removing wrecks and bank obstructions by means of shore parties, and channel obstructions by means of the snag-boat O. G. Wagner. This snag-boat has been in service since 1875, and has sustained the wear and injuries incident to snag-boat service during this time. Owing to the lateness of the season, when the last appropriation became available, only such minor repairs as were absolutely necessary were made before commencing operations. The bottom of the boat must be replated throughout before she can be used again; the crane machinery needs overhauling and repairing, and other minor repairs are necessary. The estimated cost of the necessary repairs is $7,500, and for operating the snag-boat in the river for eight months, including incidental repairs, is estimated at $19,500.

The former appropriations are as follows:

By act approved March 3, 1871	$51,000 00
By act approved June 10, 1872	100,000 00
By act approved March 3, 1873	60,000 00
By act approved August 14, 1876	12,000 00
By act approved June 18, 1878	10,000 00
By act approved March 3, 1879	10,000 00
By act approved June 14, 1880	8,000 00
By act approved March 3, 1881	12,000 00
By act passed August 2, 1882	12,000 00
By act approved July 5, 1884	15,000 00
Total amount expended to June 30, 1885	288,809 19
The amount expended on present project, including cost of iron-hull snag-boat and outfit, to June 30, 1885	175,221 32

Money statement.

Amount appropriated by act approved July 5, 1884	$15,000 00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	13,809 19
July 1, 1885, amount available	1,190 81
Amount that can be profitably expended in fiscal year ending June 30, 1887 Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	40,000 00

REPORT OF CAPTAIN P. C. MONTGOMERY.

UNITED STATES SNAG-BOAT O. G. WAGNER,
New Orleans, La., January 28, 1885.

CAPTAIN: I have the honor to submit the following report of operations of the United States snag-boat O. G. Wagner in the Ouachita and Black rivers, Arkansas and Louisiana, during the past season:

In accordance with verbal instructions received from you August 28, 1884, at Memphis, Tenn., I at once fitted out the Wagner for service and proceeded to Vicksburg, Miss., where I arrived September 4, 1884, and received your letter of instructions, of September 6, to proceed to Ouachita River, go as far up-stream as possible and then work down toward the mouth. On arriving at the Ouachita River I found a very low stage of water, and could only go to Bayou Louie Bend, Louisiana, and from there I worked down-stream, removing all obstructions to navigation. On entering the Black River I proceeded to its mouth, then worked up-stream, removing such obstructions as were necessary. I received instruction from you to proceed to the landslides below Monroe, La., as soon as the stage of water would permit, and remove them, which I did, and arrived at Monroe, La., December 24, 1884. From there I proceeded to the Upper Ouachita, and found but few obstructions on account of the high stage of water. On arriving at Mound Landing, Arkansas, I found it advisable to return to Monroe, as no work could be done on account of the extreme high stage of water. I arrived at Monroe, La., January 4, 1885, notified you and received instructions to proceed to New Orleans, La., and lay the Wagner up. I arrived at New Orleans January 14, 1885, discharged the crew and employed two watchmen. The following obstructions were removed by the Wagner during the season:

Snags pulled	677
Stumps pulled	100
Shore snags cut	2,264
Logs removed from bed of river	267
Petrified logs removed from bed of river	2
Cylinders of wreck of steamer removed from bed of river	1
Stumps blown up	18
Trees cut	7

I would respectfully recommend that operations in the Ouachita River be carried on in the same manner next season, for, while great improvement has been accomplished, there yet remains a great deal to be done, and an appropriation of $30,000 could be expended to good advantage in the improvement of the river.

In conclusion, I would say that as the improvement of the river increases the rate of freights, and insurance will be reduced, which will be of great benefit to the people living along the river, as the river is the principal means of transportation for their products and return freights. I am pleased to state that the steamboat men navigating the Ouachita River have expressed their entire satisfaction with the work done by the Wagner the past season.

Very respectfully, your obedient servant,

P. C. MONTGOMERY,
Captain Snag-boat O. G. Wagner.

Capt. ERIC BERGLAND,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

During the fiscal year twelve steamboats navigated the Ouachita River and tributaries, the five largest boats, which navigated the main stream alone, having capacities of from 500 to 900 tons each, and drawing from 7 to 9 feet of water. These

boats averaged about twenty-two trips each during the year. Boats from New Orleans ascended to Camden, Ark., from November to June, inclusive, and as high as Monroe, La., the entire year.

The following freights were carried, including those of the tributaries, all of which passed through the main stream:

Cotton	bales..	108,600
Cotton-seed	sacks..	390,000
Staves	number..	715,500
Cattle	head..	5,785
Wood	cords..	5,000
Timber	logs..	175,000

Return freights, estimated value, $2,000,000.

U 7.

IMPROVEMENT OF BAYOU BARTHOLOMEW, LOUISIANA AND ARKANSAS.

This stream is a tributary of the Ouachita River. It rises in Southeastern Arkansas, within a few miles of Pine Bluff, on the Arkansas River, and, following an exceedingly tortuous course, flows at first nearly parallel to the Arkansas River, at a distance varying from 15 to 30 miles; then parallel to the Mississippi, at about the same average distance, and after entering Louisiana diverges to the southwest and flows into the Ouachita River opposite Ouachita City.

The States of Louisiana and Arkansas have at various times expended funds for surveys and improvement of the bayou. Examinations were made by the United States in 1872 and 1879. An examination of the bayou from Baxter to the Lincoln County line, Arkansas, was made in December, 1884, the report of which (dated January 15, 1885) disapproves the present improvement of this portion of the river. The present plan of improvement is based upon a report submitted by Major Benyaurd, in 1880, estimating the cost of cutting overhanging timber and removing wrecks, snags, &c., obstructing navigation from Baxter, Ark., to the mouth, an estimated distance of 213 miles, at $26,862. At Baxter, Ark., the Little Rock, Mississippi River, and Texas Railroad Bridge crosses the bayou, forming a bar to all navigation above the crossing, except for stave-boats, of which there are a great many in this part of the stream. The work heretofore done in this stream consisted in the removal of obstructions to navigation from Baxter, Ark., to Lind Grove, La., an estimated distance of 143 miles. The work done during the year was carried on by contract. Bids were opened October 11, 1884, and the following is an abstract of those received:

No.	Names of bidders.	Prices bid per linear mile.	Date proposed to commence work.	Date proposed to complete work.
1	Wooton & Broadway	$200	November 1, 1884...	December 1, 1884.
2	Emmick & Feith	75	November 15, 1884...	December 25, 1884.

The contract was awarded to Emmick & Feith, and work was begun by them November 10, 1884, and completed December 7, 1884. This work consisted in the removal of all trees, logs, snags, wrecks, and leaning trees obstructing navigation of the bayou, and disposal of them

so they would not become obstructions again. It extended from the north up-stream 66⅔ miles.

My inspector who supervised the work reports the following aggregates: 550 stumps, 1,823 logs, 3,464 snags, 2 wrecks, and 123 brush piles were removed from the channel, and 697 leaning trees cut down.

This work, together with that previously done, has greatly improved navigation in the stream (which is only carried on during high water), by the removal of obstructions, from the parts in which it has been carried on. New obstructions, however, are continually forming, and require removal from time to time in the interests of safe navigation. The amount available is not sufficient to resume work during the coming season. The appropriation asked for the fiscal year ending June 30, 1887, can be profitably expended in cutting leaning timber, removing snags, &c., as heretofore. The former appropriations are as follows:

By act approved March 3, 1881	$8,000 00
By act passed August 2, 1882	5,000 00
By act approved July 5, 1884	5,000 00
Amount expended to June 30, 1885	17,751 32

Money statement.

July 1, 1884, amount available		$1,121 70
Amount appropriated by act approved July 5, 1884		5,000 00
		6,121 70
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884		5,873 02
July 1, 1885, amount available		248 68
Amount (estimated) required for completion of existing project		8,862 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		9,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

During the fiscal year three steamboats, drawing from 4½ to 6 feet of water, and with capacities of 125, 150, and 300 tons, made forty-two trips in the stream, extending from 45 to 290 miles above the mouth.

The bayou was navigable from November until May, and the following quantities of freight were carried during these months:

Cotton	bales..	20,000
Cotton-seed	sacks..	70,000

Return freights, estimated value, $48,000.

U 8.

IMPROVEMENT OF BAYOU BŒUF, LOUISIANA.

Bayou Bœuf rises in Southeastern Arkansas, flows in a southerly direction, and enters the Ouachita River at Stafford Point, about 10 miles above Harrisonburg, La.

The plan of improvement is based upon an examination made by the United States in 1880. The project consists in the removal of obstructions to navigation, being snags, logs, and leaning timber, from Wallace's Landing, Louisiana, to the mouth of the bayou, a distance of 280 miles, at an estimated cost of $20,000.

An examination of the three outlets of Bayou Bœuf, near Point Jefferson, Louisiana, was directed by river and harbor act of July 5, 1884. The report on this examination was submitted December 6, 1884, recommending closure of the outlets, at an estimated cost of $7,290. As it is probable that the outlets will be somewhat enlarged before any appropriation can be made for their closure, I would recommend that the former estimate be increased to $8,500, and that this amount be appropriated for the closure of the outlets in addition to the amount asked for the improvement of the river. The work heretofore done in this stream was carried on during 1881 and 1882; was begun at Point Jefferson, Louisiana, and carried down-stream as far as the funds available permitted. Navigation was greatly improved thereby, and boats were enabled to run during high water to Point Jefferson.

The work during the fiscal year was carried on by contract. Bids were opened October 11, 1884, and the following is an abstract of those received:

No.	Names of bidders.	Prices bid per linear mile.	Date proposed to commence work.	Date proposed to complete work.
1	Wooten & Broadway	$125	November 1, 1884	December 1, 1884.
2	Emmick & Feith	75	November 15, 1884	December 25, 1884.

The contract was awarded to Emmick & Feith, and work was begun by them November 15 and completed December 11, 1884.

This work consisted in the removal of all trees, logs, snags, and overhanging trees, &c., obstructing navigation, and disposal of them so as not again to become obstructions, and was carried from the mouth up-stream a distance of 60 miles.

My inspector who supervised the work reports the following aggregates: 211 stumps, 710 logs, 232 snags, and 35 brush-piles removed from channel, and 526 overhanging trees cut and removed.

The bayou is only navigable during high water. The obstructions removed have greatly benefited high-water navigation and lessened the dangers thereof. The improvement is not permanent, as new obstructions form from time to time which will require removal in the interests of safe navigation. Work cannot be resumed until further funds are available. With the appropriation asked for the fiscal year ending June 30, 1887, it is proposed to apply $5,000 to the removal of obstructions from the channel and banks, as heretofore, and $8,500 to the closure of the outlets near Point Jefferson, Lousiana.

The former appropriations are:

By act approved March 3, 1881	$5,000 00
By act passed August 2, 1882	5,000 00
By act approved July 5, 1884	5,000 00
Amount expended to June 30, 1885	14,875 68

Money statement.

Amount appropriated by act approved July 5, 1884	$5,000 00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	4,875 68
July 1, 1885, amount available	124 32
Amount (estimated) required for completion of existing project	13,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	13,500 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

During the fiscal year one steamboat, of 177 tons burden, and drawing 4½ feet of water, plied in the bayou between the mouth and a point 200 miles above, making fourteen trips, and carrying the following quantities of freight:

Cotton	bales..	15,000
Cotton-seed	sacks..	40,000
Staves	number..	50,000
Cattle	head..	1,500

with return freights of miscellaneous articles and supplies, the value of which could not be ascertained.

The bayou was navigable from November until June.

U 9.

IMPROVEMENT OF TENSAS RIVER AND BAYOU MACON, LOUISIANA.

The Tensas River has its source in the northeastern part of Louisiana, in Lake Providence, flows in a southerly direction, and, uniting with the Ouachita and Little rivers at Trinity, La., the three form the Black River. An examination of the stream was made by the United States in 1880, upon which the present plan of improvement was based. The project contemplates the removal of snags, logs, and leaning timber obstructing navigation from Dallas to the mouth, about 180 miles, at an estimated cost of $23,000. By river and harbor act of July 5, 1884, Bayou Macon was united under the same head of appropriation with Tensas River. This bayou rises in Desha County, Southeastern Arkansas, flows in a southerly direction, entering the Tensas River about 40 miles above its mouth.

An examination of the bayou was made by the United States in 1880, upon which the plan of improvement is based. The project contemplates the removal of the same class of obstructions as those in Tensas River from Floyd, La., the present head of navigation, to its mouth, about 130 miles, at an estimated cost of $17,000. The only work previously done was carried on during 1881 in the Tensas River. The small amount ($3,000) expended during that season benefited navigation to a limited extent by the removal of leaning trees, snags, and logs as far as practicable with that amount.

The work during the fiscal year was done by contract. But one bid was received (October 11, 1884), of which the following is an abstract:

No.	Names of bidders.	Price bid per linear mile.	Date proposed to commence work.	Date proposed to complete work.
1	Wooton & Broadway	$125	November 1, 1884 ...	December 1, 1884.

Contract was entered into with Messrs Wooton & Broadway, and work was begun by them October 29, 1884, and completed November 28, 1884. This work consisted in the removal of all trees, logs, snags, and wrecks from the channel and leaning trees from the banks, and disposal of them so as not again to become obstructions. The work extended from the mouth up-stream a distance of 28⅘ miles.

The inspector who supervised the work reports the following aggregates: 1,033 stumps and snags, 163 logs, and 1 steamboat wreck were

removed from the channel, and 114 leaning trees cut, and 12 leaning trees topped.

No work has yet been done in Bayou Macon, as the funds available for last season's work were not sufficient to extend it into that stream. Tensas River and Bayou Macon are only navigable during high stages of water in the Ouachita River, and the work of the past season has benefited navigation in the former by the removal of obstructions from that portion of the stream in which it was carried on. This work, however, is not permanent, as new obstructions are added from time to time, which will require removal in the interests of safe navigation.

Work cannot be resumed until further funds are available. With the appropriation asked for the fiscal year ending June 30, 1887, it is proposed to continue the removal of obstructions from the channel and banks as heretofore.

If the whole amount asked for be granted, work can be prosecuted in both streams.

The former appropriations are:

By act approved March 3, 1881	$3,000 00
By act approved July 5, 1884	4,000 00
Amount expended to June 30, 1885	6,984 66

Money statement.

Amount appropriated by act approved July 5, 1884	$4,000 00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	3,984 66
July 1, 1885, amount available	15 34
Amount (estimated) required for completion of existing project	$33,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	10,000 00

Submitted in compliance with requirements of Section 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

During the fiscal year Tensas River and Bayou Macon were navigable from November to July 1.

Three steamboats, with capacities of 87, 140, and 191 tons, respectively, and drawing from 3½ to 5½ feet of water, plied in these streams, carrying the following freights:

Cotton	bales..	20,000
Cotton-seed	sacks..	100,000

Return freights, estimated value, $35,000.

These three boats averaged twenty trips each, some of them extending 140 miles above the mouth of Tensas River and 200 miles above mouth of Bayou Macon.

U 10.

IMPROVEMENT OF BAYOU D'ARBONNE, LOUISIANA.

Bayou D'Arbonne is formed by the junction of the South, Middle, and North, or Corney Branches, near Farmerville, in Northern Louisiana. It flows in a southeasterly direction, and enters the Ouachita River about 6 miles above Monroe, La.

An examination and survey were made by the United States in 1883, and the plan of improvement is based upon the latter. The project

contemplates the removal of snags, logs, wrecks, leaning trees, &c., obstructing navigation from Stein's Bluff to the mouth, a distance of 42½ miles, at an estimated cost of $15,000. The first appropriation for the improvement was made by river and harbor act approved July 5, 1884, $5,000.

The work during the past season was carried on by contract. Bids were opened October 11, 1884, and the following is an abstract of those received:

No.	Names of bidders.	Prices bid per linear mile.	Date proposed to commence work.	Date proposed to complete work.
1	Wooton & Broadway	$200 00	November 1, 1884	December 1, 1884.
2	Emmick & Feith	197 50	October 17, 1884	November 20, 1884.

The contract was awarded to Emmick & Feith, and work was begun by them October 28, 1884, and completed December 11, 1884. This work consisted in the removal of all trees, logs, snags, and wrecks from the channel, and leaning trees from the banks, and disposing of them so that they would not again become obstructions. The work extended from the mouth up-stream a distance of 22 miles, 4,143 feet.

My inspector who supervised the work reports the following aggregates:

Three thousand one hundred and eighty-eight snags, 725 logs, 264 stumps, 205 fallen trees, 19 rock heaps, 1 fish-trap, and 2 wrecks removed from channel; 111 overhanging trees cut, and 1,570 feet of bank cleared of brush at nineteen points.

This bayou, like the other tributaries of Ouachita River, is only navigable during high stages of water in the main river. The work of the past season has resulted in the removal of obstructions from about one-half of that portion of the stream in which improvement is contemplated by the present project. The navigation of this part of the stream has been improved, and the dangers thereof lessened, by the removal of these obstructions. The work, however, is not permanent, as new obstructions are added from time to time, which require removal in the interests of safe navigation. During the coming season no work will be done, as no funds are available for its continuation. With the amount asked for the fiscal year ending June 30, 1887, it is proposed to continue the removal of obstructions to navigation, according to the project.

Money statement.

Amount appropriated by act approved July 5, 1884	$5,000 00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities, July 1, 1884	4,869 41
July 1, 1885, amount available	130 59
Amount (estimated) required for completion of existing project	10,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	5,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

During the fiscal year the bayou was navigable from December until May, and boats ascended the stream from 60 to 75 miles above its mouth. Two steamboats, one of 125 tons and the other 150 tons burden, and drawing 4½ and 5 feet of water, made twenty-six trips each, carrying the following freights:

Cotton	bales	8,000
Return freights, estimated value		$18,000

U 11.

IMPROVEMENT OF YAZOO RIVER, MISSISSIPPI.

The Yazoo River is formed by the junction of the Yallabusha and Tallahatchee Rivers, in Le Flore County, Mississippi; it is about 264 miles in length, flows in a general southwesterly direction through one of the richest sections of country in the South, and enters the Mississippi River 9 miles above Vicksburg.

An examination of the wrecks of gunboats, steamers, and other obstructions placed in the river during the late war was made by the United States in 1873, and a similar examination, which included the natural obstructions to navigation, was made in 1874. The project for the improvement contemplated the removal of wrecks, snags, logs, overhanging timber, &c., obstructing navigation throughout the entire length of the stream. The work, however, cannot be permanent. New obstructions, caused by floods, caving banks, &c., are brought into the river each year, and require removal to render navigation safe; consequently no detailed estimates for the permanent improvement of the river have been submitted.

Eleven wrecks of steamers, sunk during the late war, were removed by contract during the season of 1873–'74. During 1875 and 1877 the United States snag-boat O. G. Wagner was employed in removing wrecks and other obstructions. In October, 1879, the snag-boat John R. Meigs was completed, and the principal work of improvement since that time has been carried on with this snag-boat. The results of the work heretofore done are marked. The large number of wrecks and a great many natural obstructions, which limited the navigable season, have been removed, and the river is now navigable throughout the year.

During the past season the United States snag-boat John R. Meigs, after undergoing some necessary repairs at Memphis, Tenn., began operations September 18, 1884, which were continued without interruption until November 1, 1884, when the boat was transferred to the Tallahatchee River. Returning to the Yazoo, December 9, work was continued until the 1st of January, 1885, when, the water having reached a stage too high to continue effective work in that stream, the boat was transferred to the Big Sunflower River.

The following obstructions were removed:

Snags removed from channel	550
Projecting shore snags cut	321
Stumps cut and removed	23
Overhanging trees cut	1,773
Jams removed	6
Steamboat wrecks removed	1

Assistance was rendered three steamers, which grounded at different times in such manner as to obstruct navigation.

For details of the operations of the Meigs I would call attention to the report of Capt. P. R. Starr, submitted herewith.

The work during the past season extended over the entire river, from the mouth to the head, and the removal of the obstructions greatly improved low-water navigation; in some places the depth of water being increased from 2½ to 4 feet. The steamboat masters and pilots are unanimous in acknowledging the substantial benefits to navigation resulting from last season's work, and the efficient manner in which it was accomplished. The improvement, however, is not permanent, for vari-

ous reasons given above, and annual appropriations will be required in order to preserve and improve the navigation of the river. The amount available for the next fiscal year will be needed for the care and preservation of the United States property belonging to this improvement, hence work on the river cannot be resumed before a new appropriation becomes available.

With the amount asked for the fiscal year ending June 30, 1887, it is proposed to continue the removal of obstructions to navigation, by means of shore parties and the snag-boat John R. Meigs, as heretofore. This snag-boat has been in service since October, 1879, and has sustained the wear and injuries incident to snag boat service during this time. Owing to the lateness of the working season when the last appropriation became available, it was decided to make only such minor repairs as were absolutely necessary before sending the boat to the Yazoo. Several new plates are now required for the iron hull and deck, the boilers and machinery must be overhauled and repaired, the wooden lower deck and boiler deck require repairs and calking, and the whole boat should be repainted, &c. It is estimated that the necessary repairs will cost $5,500. The estimated cost of operating the snag-boat in the river for eight months is $19,500.

The former appropriations are as follows:

By act approved March 3, 1873, applied to the removal of eleven wrecks, sunk in the stream during the late war	$40,000 00
By act approved March 3, 1875	12,000 00
By act approved August 14, 1876	15,000 00
By act approved June 18, 1878	25,000 00
By act approved March 3, 1879	15,000 00
By act approved June 14, 1880	12,000 00
By act approved March 3, 1881	6,000 00
By act passed August 2, 1882	8,000 00
By act approved July 5, 1884	10,000 00
Amount expended to June 30, 1885	141,753 53

Money statement.

July 1, 1884, amount available	$301 18
Amount appropriated by act approved July 5, 1884	10,000 00
	10,301 18
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	9,054 71
July 1, 1885, amount available	1,246 47
Amount that can be profitably expended in fiscal year ending June 30, 1887 Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	30,000 00

REPORT OF CAPTAIN P. R. STARR.

UNITED STATES SNAG-BOAT JOHN R. MEIGS,
Vicksburg, Miss., February 5, 1885.

CAPTAIN: I have the honor to submit the following report of operations of the United States snag-boat John R. Meigs, in Yazoo River, from September 18 to November 1, 1884, and from the 9th to the 31st of December, 1884. On the 27th of August, 1884, I received orders from you at Memphis, Tenn., to take command of the Meigs, then lying at Memphis, and to examine the boat and report to you the repairs required to put her in working condition. I made the examination and reported the repairs absolutely necessary. On receiving instructions from you to repair and bring the boat to Vicksburg, the necessary mechanics were hired, part of a crew engaged, and the repairs rapidly pushed to completion. On the 13th of September, 1884, the boat left Memphis for Vicksburg, arriving at the latter place September 16. Having received your

final instructions as to the work to be done, I engaged the remainder of the crew and left Vicksburg September 18; entered the Yazoo River and commenced work the same day. I found the river at a low stage and in good condition for removing snags, as they could be taken directly from the bottom of the stream. The greater part of the obstructions were entirely out of sight, and could only be found by dragging with the drag-chain. The work was confined to the bed of the river, except in places where trees and shore snags were actually in the way of low-water navigation; cleaning out the channel so as to give fully 3 feet of water on all bars and crossings as we went up. On September 30, when within a short distance of Yazoo City, I received a very earnest request from Capt. T. R. Smith, of the steamer Katie Robbins, Capt. Marcy Johnson, of the steamer Le Flore, and E. C. Carroll, superintendent of the P. Line steamers, that I should go up to the wreck of the steamer Carrie Hogan, which was lying directly across the channel and on account of the low stage of water was a serious obstruction to passing boats. The Meigs was at once moved up to the wreck, which extended fully two-thirds of the distance across the river, with numerous snags opposite and only 30 inches of water over the wreck. All the snags in the vicinity were first pulled, and then the wreck torn up, and the greater part of it pulled out on the bank, making a good channel with fully 7 feet of water. I then worked on up the river removing obstructions from the channel only, not having sufficient force to work both the boat and a shore party at the same time. The river from the foot to head of Honey Island, a distance of some 60 miles, was in a very bad condition, no work having been done there for several years. This part of the river is very crooked and narrow, with short bends obstructed by leaning trees and many logs and snags in the channel. The points were also covered with trees and shore snags. The worst obstructions were where trees singly and then again from three to four to as many as ten or fifteen slide into the river, in many places remaining standing as erect as they were on the bank, with so much sediment clinging to the roots that it was almost impossible to pull them out.

On October 9, when above Silent Shade, the steam trading-boat Arkansas City ran on a log and was leaking badly, with no means of getting off. At the request of Captain Cook, her owner, I backed down after dark, a distance of 4 miles, and pulled her off. At Upper Gold Dust Bar, October 27, the steamer Le Flore got aground, broke her capstan, and could not get over the bar. The Meigs went to her assistance, and pulled her off the bar after working seven hours. On sounding I found only 30 inches of water on the bar, and the channel full of logs. Work was immediately begun with the drag-chain, and numerous logs and snags removed, making a good channel with 3 feet of water. At French Bend Bar, or wreck of the steamer Mary E. Keene, I found it very difficult for the boat to pass, as the wreck was lying directly in the bend of the river, which makes a very short turn to the right, with the point of a sand-bar extending out towards the middle of the wreck, and at a low stage of water the width of the river from the point of the sand-bar to the wreck was only 45 feet, and only 32 inches of water in the channel above the wreck. Having no explosives, without which nothing effective can be done towards removing this obstruction, we did not work on the wreck, but pulled several large snags in the vicinity of it. I think, with the aid of a diver and explosives, that the entire wreck could easily be removed, and its removal would greatly benefit navigation, as the bend would then wash out and make a better channel for passing boats.

We arrived at Greenwood October 30, and, after making some needed repairs to the machinery, entered the Tallahatchee River. On December 8 I received your letter of the 5th with orders to return to the Yazoo River and resume work in that stream, which was done. We commenced work at the mouth of the Tallahatchee, and continued the same down-stream until the 12th, when, receiving a letter from Capt. T. R. Smith, of the steamer Katie Robbins, asking that work be done between the head of Honey Island and Rose Bank, as the snags and logs were so numerous that boats had great difficulty in getting along, the boat was at once moved down to the head of the island and worked up to Rose Bank, thoroughly cleaning out all channel obstructions, and then commenced cutting leaning trees and shore snags on all points and bends. On the 25th of December I received a request from Capt. Frank Beck, of the sunken steamer Le Flore, for assistance in raising his boat, and accordingly proceeded down to the sunken steamer and worked the remainder of the day, but, as the river was rising rapidly, could do no good, and returned up the river to Liverpool, cutting stumps and leaning trees. On the night of December 27 the P. Line steamer De Smet, while coming down the river with a load of cotton, ran on a mud lump and got badly aground. Her captain sent for assistance, and, getting up-stream at 10 o'clock at night, we proceeded down the river one-half mile, and succeeded in pulling her off. Working on down the river, which was rising rapidly, we arrived at the mouth of Big Sunflower River December 30. On the 31st you visited the boat and gave me instructions to enter the Big Sunflower River, and commence work January 1, 1885. Having but a limited appropriation to work with, and fully appreciating the importance of pushing the work as rapidly as possible, in order to clear out a low-water

channel the full length of the Yazoo River, I did not do any work on the shore on my way up the river, except in places where it was absolutely necessary. Shortly after my return from the Tallahatchee River the Yazoo River began to rise, and we could do but little at pulling snags, but cut all the leaning trees on points and in bends where required.

I would respectfully suggest in future operations in this river that a cutting party of eight or ten laborers be sent ahead of the boat to cut trees, stumps, and shore snags. All the trees which fall into the river can then be picked up by the boat as it moves up-stream. The time thus saved will more than compensate for the cost of additional labor, as the boat will not have to stop and cut the trees and afterwards pick them up. The river is of such nature that even if thoroughly cleaned after the first rise and fall there will be just as many new obstructions. Trees are constantly sliding into the river, banks washing away and exposing logs and stumps that have to be removed from time to time. Many of the trees which fall into the river are oak, pecan, gum, and sycamore, which sink where they fall. To permanently clear the river of all obstructions is impossible, but four or more months' work in each year will greatly improve its navigation. The principal points at which work was required and performed were as follows: Haynes' Bluff, Little Deer Creek, Sunflower Bend, the Narrows, Brown's Bar, Belle Yazoo, Woodstock Reach, Annadale, O'Neil's Creek, Stella Gin, Stella, Short Creek, Phillip's, wreck of steamer Carrie Hogan, Hine's, Lodi, Hidi, Wilderness, Bermuda, Silver City, Springwood, Gum Bayou, Dew Drop, Stewart's, Tuckaho, Winter Quarters, Loosey Level, Devil's Race-Track, Random Shot, Perkins', Just Over, Idlewild, Huntsfield, Westover Gin, Montgomery Point, Salt Point, Eagle Lake Landing, Elmore's, Gold Dust, Eagle Bend, head of Honey Island, Rose Bank, French Bend, Water Front, and Double Oaks. The total number of miles run in Yazoo River was 546. The following is a summary of the work done:

Snags pulled and destroyed	550
Shore snags cut and destroyed	321
Stumps cut and destroyed	23
Trees cut	1,773
Jams removed	6
Steamboat wrecks removed	1
Extra cuts made	1,839
Total number of cuts made	5,417

Assistance was rendered to three steamboats which had grounded and were obstructing navigation.

Very respectfully, your obedient servant,

P. R. STARR,
Captain Snag-boat John R. Meigs.

Capt. ERIC BERGLAND,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

During the past fiscal year six steamboats plied in this stream, drawing from 4 to 7 feet of water, and with carrying capacities for from 250 to 2,000 bales of cotton. The river was navigable the entire year, and the boats made one hundred and seventy-one trips, or an average of over twenty-eight trips for each boat from Vicksburg to the head of the river.

The following freights were carried:

Cotton	bales..	58,350
Cotton-seed	sacks..	97,500
Staves	numbers..	50,000
Return freights, estimated value		$1,350,000

In addition to the above, a large quantity of timber and a few cattle and hogs. The boats navigating the Big Sunflower and Tallahatchee rivers and other tributaries pass up and down this stream.

The seasons of 1882–'83, 1883–'84, and 1884–'85 were all overflow years, and the crops and return freights much lessened by this cause. It is estimated that the crops of 1885–'86 will exceed any of the above years fully 25 per cent., and the return freights be correspondingly increased.

Five thousand five hundred bales of cotton were shipped from Yazoo City by railroad last season, which, with the return freights by railroad to that point, are not included in the above statistics.

U 12.

IMPROVEMENT OF BIG SUNFLOWER RIVER, MISSISSIPPI.

This river has its source at Mud Lake, Coahoma County, Mississippi, near what is known as Horseshoe Bend on the Mississippi River, flows in a southerly direction, and enters the Yazoo River about 55 miles above the mouth of the latter. During extreme high-water it is navigable as high up as Clarksdale, Miss., 280 miles from the mouth. Faisonia, Miss., 144 miles from the mouth, is ordinarily considered the head of low-water navigation.

An examination was made by the United States in 1878, and the plan adopted for the improvement consisted in building ordinary wing-dams, to scour a channel of from 3 feet to 40 inches depth, at points where necessary, and the removal of snags, sunken logs, and leaning timber obstructing navigation, at an estimated cost of $66,000.

Work was begun in 1879 and the navigation of the stream has been greatly improved by the removal of snags, logs, and leaning timber, and by deepening the water over shoal places by means of wing-dams. The following statement, obtained from the officers of the boats navigating the river, shows to what extent the navigation has been improved:

> In 1879 a boat could not make a trip under ten days, and often fifteen days. It is not a difficult matter at the present time to make a trip in six days at its lowest stages. For instance, on Oliphant's Bar, in 1879, there were but 18 or 20 inches on the crossings (11 in all). During the low-water season of 1884, at no time was there less than 33 inches on the same, and on some of them 3 feet large. We anticipate no trouble from that point in the future.

The appropriations have been as follows:

By act approved March 3, 1879	$20,000 00
By act approved June 14, 1880	8,000 00
By act approved March 3, 1881	4,000 00
By act passed August 2, 1882	5,000 00
By act approved July 5, 1884	5,000 00
The amount expended to June 30, 1885, is	41,954 62

During the fiscal year ending June 30, 1885, work has been carried on as follows:

A light-draught steamboat was chartered and work begun in the river October 12, 1884, and continued under the superintendence of Mr. Charles W. Phifer, until December 21, 1884, when the boat was discharged, having accomplished the following work during the season: Wing-dams of timber, logs, and brush were built at Oliphant's Bar, Callao, Woodburn, Johnsonville, and Hollywood, aggregating over 2,500 feet in length, and an average increased depth of 2 feet secured at these places. A number of old dams were repaired; 332 logs and 69 snags were removed from the channel, and 70 overhanging trees cut from the banks.

The wing-dams built and repaired last autumn have stood well during the recent high-water season, and are now in good condition to maintain a sufficient channel during the approaching low-water season.

Attention is respectfully invited to the report of Mr. Charles W. Phifer submitted herewith.

The United States snag-boat John R. Meigs was transferred from the Yazoo to this river January 1, 1885, and continued work until the 18th of January, removing 32 snags and 2 jams, cutting 45 projecting shore snags, 96 stumps, and 1,585 overhanging trees, and deadening 5 trees. Although the river is now in fair condition, the suspension of

work during this summer, owing to lack of funds for continuing the improvement, will necessitate a greater expenditure during the fiscal year ending June 30, 1887, as owing to sliding and caving banks and formation of new bars new obstructions to navigation are added from time to time.

With the amount asked for the fiscal year ending June 30, 1887, it is proposed to continue the removal of snags, logs, and overhanging trees obstructing navigation, and the construction and repair of wing-dams where required.

Money statement.

July 1, 1884, amount available		$1,893 58
Amount appropriated by act approved July 5, 1884		5,000 00
		6,893 58
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884		6,848 20
July 1, 1885, amount available		45 38
Amount (estimated) required for completion of existing project		24,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		15,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

REPORT OF MR. CHARLES W. PHIFER, SUPERINTENDENT.

VICKSBURG, MISS., *January* 1, 1885.

CAPTAIN: I have the honor to make the following report of the operations carried on under your instructions on the Big Sunflower River, Mississippi, during the season of 1884: Pursuant to instructions received from you on the 15th October, I left Vicksburg on that day at 6 o'clock p. m., on the regular packet Tributary, and reached the foot of Oliphant's Bar at 10 o'clock on the following day, where I found the steamer Headlight, chartered by you for work on the river, in charge of Captain Smith, who had commenced the construction of a lumber wing-dam at this point. As I did not approve of the locality, I stopped the work and moved all hands and the boat 1½ miles up the river, where I made a close lumber dam, 184 feet in length, across the bar on which the average depth of water was 22 inches. In constructing this dam I drove piles 8 to 10 feet deep and 8 feet apart into the bed of the river, which was composed of mud and sand. To these piles I fastened with spikes heavy stringers, and then nailed to the stringers 2-inch cypress boards, driven by hand about 3 feet into the sand. This dam was finished on the 18th. I then placed brush above it to break somewhat the force of the current and to catch the sand and floating débris. About 100 feet below, and almost parallel with dam No. 1, I built another similar in every respect. This dam was completed on the 21st. Next I built a dam of brush over 100 yards above, on the opposite side or right bank of the river. This was constructed by driving piling as usual about 6 feet apart, and filling in above it with a quantity of brush well trodden down and kept in place by weighting it with heavy logs of sycamore, pecan, and other such heavy timber as would sink in the water. This dam is 180 feet in length, and I believe it will be as effective and permanent as if made of lumber. It was completed on the 22d. I then moved up 3 miles to McCormick's Crossing, to the head of the bar, and made a dam 225 feet in length, which I built of piling alone, 6 by 3 inches and 10 feet in length; this I consider stronger than those previously built, though requiring more lumber.

This work was completed on the 24th. After this I repaired three old dams, sadly in need of it, and which I think are now permanent. Being informed by the master of the Tributary that it was no longer possible for boats to pass over the shoals at Callao, at his solicitation I left Oliphant's Bar on the 25th with the intention of improving the navigation of the river at that point. Arriving at Callao on the 26th work was at once commenced by driving piling for a wing-dam into a hard sand-bar. The work progressed slowly on account of insufficient labor and the want of convenient material to complete it according to the plan I had proposed. Several breaks were made in the work which took time to repair, and the brush with which reinforced it was difficult to obtain. Therefore, I failed to complete the dam until November 5. The water over the shoals, in the deepest places, was 22 inches when we began the work, and after building 225 feet of lumber dam I reasonably expected a

gain of 12 inches more. This, however, was not the case, so I built another dam 180 feet above, 260 feet in length, of logs and brush; also pulled in with the boat's capstan several sycamore and locust trees, which sank readily, thus forming a solid and substantial work, not easily carried away by the current. Upon its completion on the 11th of November I took soundings and found I had an increased average depth of 3 feet, which has by this time, in all probability, a greater depth. On the 12th I steamed up to Woodburn. *En route* I removed three logs and four snags, which before had seriously impeded the passage of boats. At Woodburn I built a dam of lumber, 70 feet in length, on the right bank of the river, and one 60 yards above, on the left bank, of logs and brush. The average depth of water on the bar before the work was done was 18 inches; now there is a depth of 3½ feet and a good channel. From Woodburn I proceeded to Johnsonville, 16 miles above, removing 43 logs and snags whose average diameter was 2½ feet and length about 60 feet. Two miles below Johnsonville there is a bar over which I made a dam 160 feet long of fallen trees and brush, pulled by capstan into the river. Another similar dam was made 180 feet above, 200 feet in length, from which resulted an increased depth of 42 inches. At Vining's, Boyer's Mill, Rainy Day, and King's Place I removed altogether 27 logs and 32 snags. At Holly Bay I removed two large logs 3 feet in diameter. On the 1st of December I left Holly Bay and moved down the river to Hollywood, Captain Red's place, where I found it necessary to build two wing-dams, each 160 feet in length. Most of the lumber with which you had provided me being expended, I made the dams of logs and brush pulled into the river with the capstan. When completed there was an average depth of 40 inches. Previously there were 32 inches over these shoals.

Supposing, from your instructions, that the manner of improving this river depended much upon circumstances, the prime object being to expend the small appropriation to the best advantage, I thought it proper to devote the unexpended balance to the cutting of timber and the removal of logs, snags, drift, and similar obstruction from the river. From December 1 to December 16 I removed 260 sunken logs and 38 dangerous snags, besides cutting 69 trees that were liable to fall at any time into the river. When engaged on this work I learned from a Vicksburg paper that the steamer Tributary had "got aground" on the upper bar at Oliphant's or McCormick's Crossing, on her last trip. I started immediately for that point, and on arriving there found 3½ feet all over the bar. The master informed me by letter, which I forwarded to you, that his boat was drawing 4 feet and was overloaded. While aground his boat lay across the channel, which caused the sand to bank up on the lower side, forming a bar in the middle of the channel below her. In order to remove this I expended the lumber I had reserved for repairs of old works by building in the usual way another dam, 190 feet long. This work was completed on the 19th of December.

Several steamboat men have expressed themselves as being highly gratified at the successful result and seeming permanency of the works on this river, which compliment I consider graceful, coming as it does from those most interested in its improvement. There are no artificial obstructions, such as bridges, dams, &c., to interfere with the navigation of the river, but the natural obstructions have compelled some of the people to send their produce to market by rail, hauling it in wagons, during rainy weather, over bad roads to the nearest station, sometimes 20 miles distant. The following amount of work was done during the season:

	Feet.
Wing-dams built at Oliphant's	969
Wing-dams built at Callao	715
Wing-dams built at Woodburn	160
Wing-dams built at Johnsonville	360
Wing-dams built at Hollywood	320
Total	2,524
Logs removed	332
Snags removed	69
Leaning trees cut	70

As to the character and amount of work necessary to be done next year, I would respectfully recommend that the greater part of it be done between Campbellville and "head of drift," a distance of 30 miles. There are more than 1,000 dangerous logs and snags in that reach, which if removed would add much to the speed and safety of boats. There are numerous trees that should be cut which at this time are liable to fall into the river at any moment. From Callao to Johnsonville, a distance of 40 miles, the same work should be done; two or three wing-dams may be necessary in this reach. From Johnsonville to William's Landing, a distance of 80 miles, work could be profitably done in case of high water, such as cutting timber and removing snags. Capt. John Auter, an old experienced pilot on the Sunflower River,

and Capt. George Smith indorse me fully in making these recommendations. As the heavy timber indigenous to this river is continually falling into it and obstructing the passage of boats, let me respectfully suggest that the banks on either side be cleared of timber to a width of 40 feet.

Very respectfully, your obedient servant,

CHAS. W. PHIFER.

Capt. ERIC BERGLAND,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

During the fiscal year boats have not gone higher up than William's Landing, Bolivar County, Mississippi, about 210 miles above the mouth. During the low-water season, Woodburn, Sunflower County, Mississippi, has been the upper limit of navigation.

Two steamboats, the Headlight, drawing 22 inches of water, with a carrying capacity of 195 tons, and the Tributary, drawing 26 inches, with a carrying capacity of 65 tons, navigated the river during the entire year, one or the other making a trip every week therein.

The following are the commercial statistics for the fiscal year ending June 30, 1885:

Cotton	bales	8,500
Cotton-seed	sacks	22,700
Cattle	head	208
Hogs	do	600
Staves	number	600,000
Rafting timber	feet	10,000,000
Ash logs	do	4,000,000

Return freight, estimated value, $700,000.

U 13.

IMPROVEMENT OF TCHULA LAKE, MISSISSIPPI.

When the Yazoo River reaches the head of Honey Island, about 220 miles above its mouth, it divides into two branches, the westerly one retaining the name of the river, while the easterly and narrower branch is named Tchula Lake or River. The distance from the head to the foot of the island, where the two branches again unite, is about 67 miles.

The country along the lake is highly cultivated, and very productive plantations join one another along its banks. The amount of cotton raised annually is estimated at about 20,000 bales, all of which would be brought out through the lake if it were navigable the entire year.

An examination was made by the United States in 1879, and the project for its improvement contemplated the removal of snags, logs, overhanging trees, &c., obstructing nivigation, to enable boats of light draught to enter the lake earlier in the season. The estimated cost of this improvement was $10,000. The work of improvement was begun in 1881 and continued in 1882. The navigation of the lake was greatly improved by the removal of overhanging timber, snags, &c., and light-draught boats were enabled to enter the lake earlier and run much later during the season.

During the past season the working party in charge of Mr. Walter S. Davis, assistant engineer, whose report is submitted herewith, was transferred from the Yallabusha River December 22, 1884, and began operations at the head of the lake, continuing down-stream and removing such obstructions as would be of greatest benefit to immediate naviga-

tion and could be removed advantageously during the high stage of water at that time. On February 11, 1885, the party reached the foot of the lake and were discharged, having removed the following obstructions during the season:

Overhanging trees cut	190
Overhanging trees topped	48
Trees girdled	718
Logs and snags removed from channel	111
Drift-piles removed	3

This work greatly benefited the immediate necessities of navigation, as many of the trees removed had fallen into the lake and obstructed the channel. Many troublesome sawyers, which had been there for years, were also removed from the channel. Much work, however, remains to be done during low-water in order to benefit navigation during medium stages. As new obstructions are continually forming, the improvement cannot be said to be permanent, and appropriations will be needed from time to time if the stream is to be kept in a navigable condition. Should an appropriation be made for the fiscal year ending June 30, 1887, it is proposed to continue the removal of the bank and channel obstructions as heretofore.

As this stream is really nothing but a branch of the Yazoo River, it is recommended that future appropriations for its improvement be included in the general appropriation for the Yazoo River.

The following appropriations have been made for this work:

By act approved March 3, 1881	$3,000 00
By act passed August 2, 1882	2,500 00
By act approved July 5, 1884	1,500 00
Amount expended to June 30, 1885	6,574 16

Money statement.

July 1, 1884, amount available	$271 46	
Amount appropriated by act approved July 5, 1884	1,500 00	
		1,771 46
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884		1,345 62
July 1, 1885, amount available		425 84
Amount that can be profitably expended in fiscal year ending June 30, 1887 Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		5,000 00

REPORT OF MR. WALTER S. DAVIS, ASSISTANT ENGINEER.

VICKSBURG, MISS., *April* 3, 1885.

CAPTAIN: I have the honor to submit the following report on the improvement of Tchula Lake, Mississippi, made under your instructions during the last season. Immediately after finishing operations on the Yallabusha (December 22, 1884) I floated my boat down Yazoo River to the head of Tchula Lake, and commenced work there with the outfit and party I had employed in Yallabusha River. The water in the lake was rather high to allow the removal of submerged logs and snags, and I would have suspended operations to await its fall but for the fact of there being many fallen trees in the lake obstructing navigation, and the urgent necessity of removing them at once for the benefit of the season then at hand. Besides, the high water afforded means of pulling from the channel many troublesome sawyers that had been there for years. By referring to Maj. W. H. H. Benyaurd's report on improvement of Tchula Lake (pages 1552 to 1554, Appendix P, Chief of Engineers' Report for 1882) and to Maj. A. M. Miller's report on same for the following year (pages 1150 to 1152, Appendix R), sufficient information will be found as to the condition of Tchula Lake and the kind

of improvement required without giving a detailed statement in this report. I would repeat, however, that while the lake banks are generally shelving and not liable to abrasion except in two or three places, still the nature of the earth is such that during the high-water season it becomes very soft and sloughs or subsides, inclining the large timber over the lake to such an angle as to make its navigation dangerous. Again, during heavy winds in the spring, big trees are blown down into the lake, remaining stationary at their roots. In this instance a passing steamboat has to tear its way through the branches of these fallen trees at no small risk of damage and loss. I would suggest as a remedy for such difficulty the deadening or girdling of all large trees within 100 feet of the top of the banks. Whenever this has been done on Tchula Lake or other streams, the dead trees decay and fall to pieces within a few years, or, if they blow down, break up and float off out of the way. In Mr. H. C. Wilson's report of work done in 1881 (see Appendix P, 1882, page 1553) is found the following: "The whole length of the lake we found a net-work of logs lying on the bottom with arms projecting upwards. These were all cut off to the water surface, and as much below as possible. Boats will not run through the lake until the water is at least 6 feet above the stage at which I found it, on account of a sand-bar at the head, and as none of the boats draw more than 6 feet of water, these snags will prove no further obstruction until the sand-bars are removed, when they will also have to be cut down." This is true enough so far as concerns boats that would pass through the lake, but there is water enough to allow small boats to run during eight or ten months in the year as high as the bars mentioned in former reports, and they could give transportation for all produce and merchandise in the surrounding country if the snags, stumps, and logs below low-water surface were removed. Neither had Mr. Wilson then, nor I the following year, any means of taking out or destroying this obstruction. Whether the increased amount of commerce would be sufficient to justify low-water improvement is more than I am able to state, but I think it probably would. The plan I would suggest for low-water improvement of Tchula Lake is similar to that given in my report on Yallabusha River, that is, to remove or destroy obstructions with dynamite. Besides the above-mentioned improvements, it will be necessary to remove from the channel the wreck of the steamboat Clara S., that sunk in 1883, a mile below Richardson's Quarters. The lake was too high to remove this wreck when the work was done last season.

The following work was done in Tchula Lake during the season:

Locality.	Distance, miles.	Month.	Number of overhanging trees cut.	Number of overhanging trees topped.	Number of trees girdled.	Number of logs, snags, and fallen trees removed.	Number of driftheaps removed.
From Marksville to Clifford	4½	December, 1884	55	.....	54	14	.....
From Clifford to Holly Bank	20½	January, 1885	124	39	582	66	2
From Holly Bank to Roseneath	42	February, 1885	11	9	82	31	1
Total	67	1⅔ months	190	48	718	111	3

(Distances according to pilots' estimates.)

The Yazoo River Packet Company report about the same amount of freight shipped through the lake as has been for the last two or three years.

Very respectfully, your obedient servant,

WALTER S. DAVIS,
Assistant Engineer.

Capt. ERIC BERGLAND,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

During the fiscal year four steamboats, drawing from 18 to 22 inches light, and from 4 to 6 feet loaded, with carrying capacities of from 250 to 1,400 bales of cotton, navigated this stream from December to May, inclusive, carrying the following freights:

Cotton	bales..	10,000
Cotton-seed	sacks..	25,000

Return freights, estimated value, $300,000.

U 14.

IMPROVEMENT OF TALLAHATCHEE RIVER, MISSISSIPPI.

The headwaters of this river are in Tippah and Union Counties, in the northern part of Mississippi. It flows in a southwesterly direction until it is joined by the Coldwater River, in Quitman County, and thence as the main stream it flows in a southerly direction until, united with the Yallabusha River, in Le Flore County, the two combined form the Yazoo River. An examination of the river was made by the United States, and report submitted in January, 1879. The project based thereon contemplated the removal of snags, sunken logs, and overhanging timber obstructing low-water navigation, from its junction with the Coldwater to the mouth, a distance of 165 miles, and also removal of the wreck of the steamer Star of the West, lying in the channel, 8 miles above its mouth.

The estimated cost of such improvement was $40,000. An additional examination was also made in 1880 to obtain further information in regard to the river and the necessity of continuing the improvement. The work of improvement was begun in 1879, and continued during 1880, 1881, and 1882. Part of the appropriations of 1880 and 1881 and the entire appropriation for 1882, $10,000 in all, were expended above the mouth of the Coldwater to Batesville, as required by the appropriation acts. This portion of the river, however, was not included in the original estimate of cost. The work done resulted in the removal of a large number of obstructions, and greatly increased the capacity of the river for navigation.

In 1882 a small steamer was built for navigating the Little Tallahatchee from Batesville to the mouth of the Coldwater, on which portion of the river there had not been a steamboat since the war.

The United States snag-boat John R. Meigs, in command of Capt. P. R. Starr, was transferred from the Yazoo River to this stream the 1st of November, and continued work until December 6, 1884, when, the available funds being exhausted, the boat returned to the Yazoo. The work was begun at the mouth, and continued up-stream a distance of about 25 miles. The water was at a low stage and furnished a good opportunity for removing the obstructions from the bottom of the river, which was almost covered with a net-work of logs, stumps, and snags, and operations were confined principally to that class of work.

The following obstructions were removed:

Snags pulled from channel	653
Shore snags cut	171
Stumps cut	33
Side-jams removed	2
Trees cut from channel and banks	417
Trees girdled	140

From 3 to 5 feet of the wreck of the Star of the West, projecting above the water's surface, were cut down and cleared away.

This portion of the stream in which the above work was done was the worst obstructed, and the removal of so many dangerous channel obstructions has greatly benefited navigation, steamboat men pronouncing it the most effective and useful work ever done in the river.

Previous to improvement the Big Tallahatchee River, from the mouth of Coldwater to the Yazoo, was navigable during about six months of the year. The boats from the Yazoo are now enabled to run up to Sharkey's Landing, 100 miles above the mouth, during the entire year,

but seldom make trips above that point at any stage, their owners claiming that the amount of commerce will not justify them. Many dangerous obstructions yet remain in the river, the removal of which would greatly benefit navigation. New obstructions, caused by sliding and caving banks, are also continually forming, and no permanent improvement can be effected on this account. It is, however, important to planters and others living along the banks that the river should be kept in good navigable condition, as it is the only available outlet for their products and return supplies. With the amount asked for the fiscal year ending June 30, 1887, it is proposed to continue the removal of obstructions from the channel and banks as heretofore. Should the whole amount asked for be appropriated the work could be carried on in both sections of the river; but with a smaller amount available, the interests of navigation would be best promoted by continuing the improvement of the Lower or Big Tallahatchee River.

The following appropriations have been made for this work:

By act approved March 3, 1879	$6,000
By act approved June 14, 1880	9,000
By act approved March 3, 1881	3,000
By act passed August 2, 1882	3,000
By act approved July 5, 1884	3,000
Amount expended to June 30, 1885	24,000
Above Coldwater	10,000
Below Coldwater	14,000

Money statement.

Amount appropriated by act approved July 5, 1884	$3,000 00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	3,000 00
Amount (estimated) required for completion of existing project	26,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	10,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

During the fiscal year six steamboats, drawing from 22 to 36 inches light, and from 4 to 7 feet loaded, and with carrying capacities ranging from 250 to 2,000 bales of cotton, navigated the lower river during the entire year, averaging twenty-eight trips for each boat, and carrying the following quantities of freights, viz:

Cotton	bales..	10,950
Cotton-seed	sacks..	55,110

Return freight, estimated value, $300,000.

A large quantity of lumber is also sent out of the river annually.

A small steamboat, with a tonnage of 75 tons, and drawing 14 inches, plies in the upper river, between Batesville and the mouth of Coldwater during high water, but the quantities of freight carried could not be ascertained.

U 15.

IMPROVEMENT OF COLDWATER RIVER, MISSISSIPPI.

This stream rises in the northwest corner of the State, flows in a southerly direction, and empties into the Tallahatchee River in Quitman County.

An examination was made in the winter of 1878, and estimate submitted for the improvement of the river from Yazoo Pass to its junction with the Tallahatchee, a distance of about 80 miles. The obstructions were found to be numerous snags, logs, and overhanging trees, extending

throughout its entire length, and the project contemplated the removal of these at an estimated cost of $25,000.

The work of improvement was begun in 1879, and was continued in 1880.

The work was principally done in the lower part of the river, from the mouth to Neal's Landing, a distance of about 35 miles.

In his annual report for 1881, Major Benyaurd states:

> No appropriation was asked for last year, and none will be asked for this year, as the nature of the Coldwater is such that boats could not navigate it with safety without the expenditure of a large amount of money, which I do not deem the commerce of the country would warrant at the present time. The upper portion of the river is obstructed for several miles by solid jams from one-quarter to one-half of a mile in length, resembling those on Red River above Shreveport, La., before their removal; and the navigable portion of the stream runs through a thinly-settled country, a large portion of the land being covered with heavy cane and timber.

Subsequent reports contain similar recommendations.

During the past season no work was done, the amount available being too small for fitting out even a small party.

No further appropriation is asked for this improvement. The river is only navigable during the highest stage of water in the Yazoo and Tallahatchee rivers, and then navigation is good and about as safe as that of the latter.

To secure safe navigation at lower stages would require a greater expenditure than the commerce of the country would warrant.

The following appropriations have been made for this work:

By act approved March 3, 1879	$7,000
By act approved June 14, 1880	4,000
Amount expended to June 30, 1885	11,000

Money statement.

July 1, 1884, amount available	$485 84
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	485 84

COMMERCIAL STATISTICS.

The boats navigating the Yazoo and Tallahatchee rivers sometimes make two or three trips each year into the Coldwater. The commerce of the latter river alone would not justify these occasional visits, but they are merely an extension of the round trip from Vicksburg, Miss.

U 16.

IMPROVEMENT OF YALLABUSHA RIVER, MISSISSIPPI.

The Yallabusha is a small stream about 90 miles in length. It has its source in Calhoun County, Mississippi, flows through Grenada and Le Flore counties, and unites with the Tallahatchee at a point 3 miles above Greenwood, forming the Yazoo River.

An examination of the river was made in 1879, and the plan of improvement consisted in the removal of snags, sunken logs, leaning timber, &c., obstructing navigation from Grenada, Miss., to the mouth, a distance of 63 miles.

The bridge of the Chicago, Saint Louis and New Orleans Railroad, and also a highway bridge, crossing the river at Grenada, are barriers

to navigation above that place. The original estimate of cost of improvement was $7,000, which amount was appropriated, and expended during 1881, 1882, and 1883. It was found, however, that new obstructions, caused by caving banks, &c., were continually forming and required removal in the interests of safe navigation.

The improvement was begun in 1881. The work heretofore done has resulted in the removal of the principal obstructions from the channel and banks for 42 miles up-stream from the mouth.

During the present year work was begun at Grenada, the head of navigation, the 1st of October, and continued down-stream to the mouth. On December 22, 1884, the available funds being exhausted, the working party was transferred to Tchula Lake.

The following work was done during the season:

Overhanging trees cut	2,296
Trees girdled	261
Logs cut and removed from channel	1,778
Snags cut and removed from channel	2,521
Drift-heaps removed from channel	26

For details of operations I would respectfully call attention to the report of Assistant Engineer W. S. Davis, submitted herewith.

As a result of the improvement the stream is now navigable five or six months of the year, or during high and medium stages of water. As there are no funds available for the prosecution of the work of improvement during the present low-water season, obstructions will accumulate before another appropriation can be made.

With the amount asked for the fiscal year ending June 30, 1887, it is proposed to continue the removal of obstructions from the channel and banks as heretofore.

The appropriations for improving this stream have been as follows:

By act approved March 3, 1881	3,500
By act passed August 2, 1882	3,500
By act approved July 5, 1884	2,000
Amount expended to June 30, 1885	9,000

Money statement.

Amount appropriated by act approved July 5, 1884		$2,000 00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884		2,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	5,000 00	
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

REPORT OF MR. WALTER S. DAVIS, ASSISTANT ENGINEER.

VICKSBURG, MISS., *March* 31, 1885.

CAPTAIN: I have the honor to submit the following report of operations on Yallabusha River, Mississippi, during the last season:

In compliance with your instructions, received September 23, 1884, I proceeded to Grenada, the head of navigation of Yallabusha River, and there organized a working party, consisting of thirteen laborers and a cook, and built a flat-boat, or covered barge, 32 feet long by 12 feet wide, for quarters, storage, &c. This barge is divided into kitchen, store-room, and sleeping apartment, the latter serving also as an office. In consequence of the small depth of water over the sand-bars, I constructed this boat so lightly that it draws only a few inches of water. In order that it may be better understood why the greater part of the work was done in that part of the river immediately below Grenada, it will be necessary to give a description of the nature and condition of the stream when the work commenced. From Grenada to the mouth of Yallabusha River is 63 miles (pilots' estimate, 130 miles). Its confluence here with the Big Tallahatchee River forms the Yazoo. From this point to Greenwood, on the

Yazoo, is 3 miles. The lower stretch, or from Grenada down, has an average width of more than 300 feet, and in many places more than 500 feet. For 50 miles below Grenada the course of the river is extremely tortuous, and its bed filled with big sand-bars, logs, stumps, &c. The lower 13 miles is comparatively good; 21 miles below Grenada, or at Tuscahoma Ferry, the river leaves the hill country and enters the Mississippi-Yazoo Delta. This being the worst obstructed part of the river, and the lower 42 miles having been improved in 1882, I spent most of the season in it. The work of improving the river consisted in the removal from the channel of logs, stumps, snags, and drift-heaps, and in clearing from the banks all trees likely to cave in and thereby form obstructions. Besides this, many leaning trees were girdled. In consequence of the very low stage of water, the only practicable way of removing the obstructions was by cutting or sawing them into short pieces and pulling them out of the main channel with blocks and tackle rigged on the banks. The following is a tabulated statement of work for each month, from October to December 22, the time at which I left the river:

Months.	Number of trees cut from banks.	Number of trees girdled.	Number of logs cut.	Number of snags cut or removed.	Number of drift heaps removed.	Distance worked, miles.
October	1,414	.....	783	964	20	9
November	800	261	781	1,085	6	12
December	82	.....	214	472	.....	42
Total	2,296	261	1,778	2,521	26	63

The average daily cost of rations for the whole time was 25⅜ cents each. Late in the winter of 1884 and during a part of the following spring a small stern-wheel steamboat, the Williams, owned by the Cotton-seed Oil Company, of Grenada, made regular trips from Greenwood to Grenada, carrying up cotton and cotton-seed, and returning with sundry freight for plantation supplies along the river.

From the Grenada Oil and Compress Company I learned that the amount of cotton-seed transported was 5,000 tons, worth	$70,000
Estimated value of other freight	5,000
Total	75,000

The same company informed me that they could have shipped 15,000 tons of seed if the river had been sufficiently cleared of logs and snags, and will probably ship that amount this season. Grenada is the principal shipping point on the river, but as there is not a sufficient depth of water over the sand-bars to allow the passage of steamboats, except for five or six months in the year, the merchants there and planters in the vicinity prefer to ship by railroad. The reason assigned for not patronizing the river during the short time it is navigable is because the railroads hold an undisturbed monopoly and would increase their freight rates, they say, as soon as the water gets too low to navigate. They think, however, that if the river could be so improved as to give them eight months' navigation they could during this time ship the entire cotton crop and most of the other freight.

The commercial statistics of Grenada are as follows:

Average number of bales of cotton shipped annually for the last three years, 18,000.

Value of cotton, at $50 per bale	$900,000
Value of other freights, estimated	600,000
Total	1,500,000

The sand-bars mentioned above were caused almost entirely by large quantities of sunken logs caught in drift-heaps years ago. Before the formation of these drift-heaps, say fifty years ago, the river was clear and deep, and afforded good navigation for keel-boats from November until the following July or August. I think that if the logs that are below low-water surface could be blown out with dynamite the swiftness of the current during high-water season would cause the sand-bars to disappear

and that the river would become deep again as formerly. Some of the Grenada merchants assured me that if such results could be obtained the greater part of freight shipped from there would go by river.

Very respectfully, your obedient servant,

WALTER S. DAVIS,
Assistant Engineer.

Capt. ERIC BERGLAND,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

Grenada, the head of navigation, is the principal distributing point for this stream.

During the winter and spring of 1884–'85 a small steamboat made regular trips from Greenwood, on the Yazoo, to Grenada, carrying up cotton and cotton-seed, and return freights of plantation supplies, &c. The following are the commercial statistics of Grenada, according to an average of the last three years' shipments: Eighteen thousand bales of cotton, valued at $900,000; estimated value of other freights, $600,000.

The principal portion of this, however, is shipped by rail, but it is thought that if the river were made navigable for eight months in the year, the entire cotton crop and a large portion of other freights would be shipped by that route.

During the past year the Grenada Oil and Compress Company received by river 5,000 tons cotton-seed, valued at $70,000; other freights valued at $5,000.

This company will probably increase their shipment of seed to 15,000 tons during the next year, on account of the improved navigation by last season's work.

U 17.

IMPROVEMENT OF STEELE'S BAYOU, MISSISSIPPI.

This bayou is a branch or tributary of the Yazoo River. It rises in Swan Lake, Washington County, Mississippi, flows in a southerly direction, parallel to the Mississippi River, and enters the Yazoo about 12 miles above its mouth. The bayou is about 85 miles long; the fall is very slight, and the lower portion is filled at high water from the backing up of the waters of the Mississippi River, and is navigable then for small steamboats, which run up the stream from Vicksburg.

An examination of the bayou was made by the United States in 1883. No estimate of cost of improvement was submitted by the United States engineer officer in charge, but his assistant, who made the examination, reports the probable cost at $14,960.

The first appropriation for the improvement was made by river and harbor act of July 5, 1884 ($2,500), and the project for its expenditure contemplated the removal of obstructions to high-water navigation, consisting of overhanging timber, logs, stumps, &c., as far as practicable with that amount.

Assistant Engineer William Porterfield organized a working party of fifteen men, and began work the 1st of November, 1884, which was continued until February 11, 1885, when work was stopped by the exhaustion of available funds. The work done consisted in the removal of the principal obstructions only. Operations were begun at the foot of Swan Lake and continued down-stream to the mouth. After reaching Murray's Ferry, about 44 miles above the mouth, the stream had reached such a high stage, caused by backwater from the Mississippi River, and also by the water from the Mississippi flowing through Muddy Bayou into Steele's Bayou, that the work had to be confined principally to the removal of leaning trees, which was continued until the funds were exhausted.

The following obstructions were removed during the season:

Trees cut and removed	2,252
Snags cut and removed	684
Logs cut and removed	57
Trees deadened	56
Points cleared of brush	43
Rack-heaps removed	55
Steamboat wrecks removed	1

The work carried on during last season has principally benefited navigation during high water. Much yet remains to be done before navigation at medium stages can become practicable and profitable. The upper part of the bayou and the borders of Lake Washington and Swan Lake furnish the products which are shipped through it. The lower portion is subject to overflow from backwater, and not much of it is under cultivation. The west side of Lake Washington is not far from the Mississippi River, and a branch of the Louisville, New Orleans and Texas Railroad has now been completed from Greenville, south, to near the Issaquena County line, whence it will probably be continued to the main line near Rolling Fork. This is located between Swan Lake and Lake Washington, and will no doubt absorb much of the carrying trade that would otherwise be tributary to Steele's Bayou.

As the principal crop, cotton, is ready for shipment before there is sufficient water in the bayou for navigation, much of it will undoubtedly be carried by wagon to the railroad or Mississippi River for shipment; consequently the continued improvement of the bayou may not show a corresponding increase of shipment by this route. In order to facilitate the navigation of Lake Washington, Washington Bayou, which connects it with Steele's Bayou, should be included in the improvement of the latter. This bayou is about 6 miles long. With the amount asked for the fiscal year ending June 30, 1887, it is proposed to continue the removal of the channel and bank obstructions as heretofore.

Money statement.

Amount appropriated by act approved July 5, 1884	$2,500	00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	2,374	74
July 1, 1885, amount available	125	26
Amount that can be profitably expended in fiscal year ending June 30, 1887 Submitted in compliance with the requirements of section 2 of river and harbor acts of 1866 and 1867.	5,000	00

COMMERCIAL STATISTICS.

During the fiscal year two steamboats navigated the bayou between December 1, 1884, and May 1, 1885, from its mouth to Washington Bayou, and thence to the head of Lake Washington, a total distance of 125 miles. The larger boat, drawing 22 inches, light, and with a capacity of 150 tons, accompanied by a barge of 100 tons, made sixteen trips. The smaller boat, drawing 26 inches, light, with capacity of 100 tons, and with a barge of 125 tons, made one trip. A tow boat of 400 tons also navigates the bayou.

The following quantities of freight were carried:

Cotton	bales	18,000
Cotton-seed	sacks	95,000
Cattle	number	425
Hogs	do	650
Staves	do	250,000
Lumber	feet	500,000

With return freights estimated at two-thirds the value of those brought down the stream.

U 18.

IMPROVEMENT OF BIG BLACK RIVER, MISSISSIPPI.

This stream rises in Webster and Choctaw counties, Mississippi, flows in a general southwesterly direction, and enters the Mississippi River at Grand Gulf, Mississippi, having an estimated length of about 400 miles.

The bridges of the Louisville, New Orleans and Texas Railroad, about 15 miles above the mouth, and the Vicksburg and Meridian Railroad, 90 miles above the mouth, neither having draws, form obstructions to free and safe navigation at all stages of water. Two highway bridges, respectively 25 and 78 miles above the mouth, also form barriers to navigation, neither being provided with draws. The river above the first railroad bridge is, at present, only navigated by flat-boats, carrying staves, &c. Old settlers assert that, previous to the building of the railroads, large quantities of cotton and produce were annually shipped down the river in flat and keel boats, and it is probable that if the bridge obstructions were remedied, and the bank and channel obstructions removed, at least a portion of the commerce of the country bordering the river would find a way to market by this route to the Mississippi River. Owing to the comparatively short distances between points on the lower Big Black River and the different railroads which border and cross it, as well as its proximity to the Yazoo River at Satartia, it is impossible to form any estimate of the benefits to be derived from the thorough improvement of the river from Cox's Ferry to its mouth. An examination of the stream was made by the United States in 1881, and the project for its improvement consisted in the removal of snags, logs, overhanging timber, and several wrecks obstructing navigation, from the mouth to Cox's Ferry, a distance of 130 miles, at an estimated cost of $32,000.

The first appropriation for this improvement ($5,000) was made by river and harbor act approved July 5, 1884. The work was in local charge of Mr. W. Porterfield, assistant engineer, whose report thereon is submitted herewith. Operations were begun at the mouth October 5, 1884, and continued upstream a distance of 75¼ miles. The force was discharged March 21, 1885, having removed the following obstructions during the season:

Overhanging trees cut	20,987
Trees girdled	3,744
Snags removed from channel	1,791
Logs removed from channel	2,063
Rock heaps removed from channel	48
Stumps cut	695

A large jam of logs and brush which had formed at the piers of the old Louisville, New Orleans and Texas Railroad Bridge, completely obstructing the channel, was removed in March, 1885.

This work has resulted in the removal of the principal obstructions from the banks and channel, and greatly increased the facilities for navigation on that portion of the river in which it was done.

While the present artificial obstructions remain steamboats cannot ascend the river at any stage, hence the removal of natural obstructions would only facilitate flat-boat and stave-boat navigation. For these reasons it is thought that for the present no additional funds are required for the improvement of this river. Should, however, an appropriation be made for the fiscal year ending June 30, 1887, it is pro-

posed to apply it with the balance available to the removal of obstructions, as in the past season.

Money statement.

Amount appropriated by act approved July 5, 1884	$5,000 00
July 1, 1885, amount expended during fiscal year	4,120 27
July 1, 1885, amount available	879 73
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	27,000 00

REPORT OF MR. W. PORTERFIELD, ASSISTANT ENGINEER.

VICKSBURG, MISS., *April* 1, 1885.

CAPTAIN: I have the honor to submit the following report of operations on the Big Black River under my immediate supervision during the season just closed.

In obedience to instructions received from you, the necessary outfit, supplies, and men were secured, and the party left Vicksburg in skiffs October 5. The water being very low in the Mississippi River at this time, I feared that I would be unable to cross the bar of mouth of Big Black River if I attempted to transport my whole outfit in skiffs; therefore the lightest portion only was carried in skiffs, the remainder being freighted by the Louisville, New Orleans and Texas Railway to Allen's Station, the point at which this road crosses Big Black River. Owing to the shoal water and mud-bar formed at the mouth of Big Black River, caused by the cut-off formed by the Mississippi opposite the mouth of Big Black River, I was very much delayed in arriving at my first camp. A bar of about 1 mile in width, composed almost entirely of river mud, is thrown up directly across the mouth of Big Black River, making it impossible for boats to enter the river when the Mississippi at Vicksburg is below 18 feet on the gauge. I arrived at Allen's Station the night of the 6th, secured the rest of my outfit, then proceeded to my camp at Hunter's Rest.

My first camp was located about midway between the Louisville, New Orleans and Texas Railway and the mouth of the river, 5 miles either way. The work in this stretch was the felling of trees along the slope of the banks chiefly. A few snags were also destroyed, and some timber deadened in the bends where slides occurred. Willow was the variety of timber growing along the slopes, all of which was entirely cleared. The trees were cut in lengths of about 20 feet, and the trunks deprived of their branches. Lower Big Black at this time having all the characteristics of a reservoir, the country being very low and flat and current imperceptible, quite a mass of drift accumulated in the lower portion of the river, but as the stream is about 250 feet wide at low-water stage, below the bridge, no danger of a jam was anticipated. The above plan of improving the river was pursued throughout the next two stretches, extending from the mouth to Hankerson's Ferry, a distance of 50 miles. At the crossing of the Louisville, New Orleans and Texas Railway the road was using a narrow-gauge, reinforced, combination bridge as a temporary crossing, and about 400 feet below was constructing an iron pin-connected bridge, which was completed before my departure from that vicinity. This bridge is located askew to the line of current, and the position of north pier of the channel span offers a serious impediment to the continuous flow of drift. The old bridge had a channel span of 120 feet, and a shore span on either side of 75 feet. The new bridge has a channel span of 150 feet and shore spans of 75 feet each. Piers of both are of wooden piles. Both of these structures formed a complete bar to navigation. The channel span of the new bridge is of such length that a draw of ample size could be constructed at any time. From the bridge up to Marshall's Landing, a distance of 10 miles, the river has the same general appearance that it has at the bridge; that is, wide, deep, with high sloping banks, covered with willow trees growing as thick as it is possible for them to flourish. This stretch was improved in the same manner as the preceding, the character of work being the same. With the limited appropriation it was not deemed advisable to deaden any trees that were not growing in abrupt bends or in narrow channels; hence the distance from point of beginning work to completion was much increased. As we advanced up-stream the velocity of the current rapidly increased, showing that slope lines of the valley are irregular. I experienced considerable difficulty in doing thoroughly good work, owing to this increase of current, from the fact that all trees growing on the slopes were inclined towards the stream, and one or two cuts from an ax would cause them to split and fall, the rapidity of the current sweeping them some distance down-stream

before they could be overtaken by a skiff and cut up. Finding that it was impossible to prevent the escape of some of these trees before they were cut in lengths, I resorted to a plan of making a line fast to them, one end above and the other below the cut, so that when they fell in the water I could saw them in lengths before setting them adrift. The work was much more satisfactory afterwards. The only difference between the next stretch, which extended from Marshall's Landing to Hankerson's Ferry, and the one just passed over is that the river is more sinuous, narrower, and contained two ledges of rock that extended entirely across the stream. The character of the rock is soft limestone, which can readily be removed. A little deadening of trees was done in this stretch, for the reason that many slides were observed, and some heavy timber was found which showed a tendency to cave; I therefore girdled the trees instead of felling them.

When I reached Hankerson's Ferry the effect of the winter rains which had lately begun became apparent, the oscillations in the river becoming rapid, great (sometimes reaching 20 feet), and very frequent, an apparently slight shower causing a rise of several feet in a few hours, and a corresponding fall in the few succeeding hours. Not long after this irregular motion of water commenced the Mississippi River began to rise rapidly. After passing the 35-foot stage (Vicksburg gauge) its waters began to flow in and fill the lower Big Black Basin; when a 40-foot stage was reached the country adjacent to the mouth of the river was almost completely inundated. The only effect that this rise had on the Big Black River in the vicinity of Hankerson's Ferry was to extend the period between the rise and fall of the river but not to decrease the velocity of the current in the least. The thorough work that was done to improve the river to Hankerson's Ferry produced the gratifying result of reducing the high-water level throughout the swamps. This is the first season within the memory of planters along Big Black below Hankerson's Ferry that the adjacent country has not been overflowed; this season the river was not out of its banks, and it is attributed to the work done below to free the river of obstructions. My work on the stretch extending from Hankerson's Ferry to Big Sand Creek was conducted in a somewhat different manner. Having this irregular flow of water to contend with, I was compelled frequently to cut the trees at a point some distance from the surface of the earth, and allow the stumps to remain until the water subsided, which always occurred in a day or two afterwards. The land also becoming very low and flat it became necessary to deaden a great many trees. The river being much narrower and many oak and sycamore trees having slid into the stream, many obstructions were found, and at two points immense piles of drift had accumulated. While at work clearing away the lower jam the upper one broke, floated down against the lower one, carrying both away. Feeling secure about the condition of the river below me, the railroad company having agreed to remove the old bridge immediately after the completion of the new one, and this being the only impediment to the continuous flow of the drift, I was glad to see the jams break and go. I proceeded with my work above the Ivanhoe Bridge. This bridge is a highway bridge, Howe truss, of five spans, the channel span being 80 feet long. This is another bar to navigation, though a great convenience to planters on both sides of the river.

After arriving at the mouth of Big Sand Creek I received information from you that a jam had formed at the old railroad bridge. I immediately proceeded with my party to the railroad crossing, where I found that the old bridge had not been dismantled, and that the drift-pile that broke at or near Big Sand Creek had floated the whole distance without lodging a tree until it reached this bridge. Two flat-boats, loaded with 50,000 oak staves each, had drifted down the river behind this mass, and run against it with the full velocity of the current, making the jam more compact. To add to the solidity of the mass, two of the trusses of the old bridge lay on it, one having been cut and the other burnt down. During the progress of clearing away this obstruction I received orders to close work for the season on Big Black (immediately after I had secured an open channel at the bridge), and report at Vicksburg, which instructions I followed.

The valley of Big Black is very fertile and productive; except where the Walnut Hills intercept the valley, cultivation is continuous on either side. The slopes incline rapidly to the river, rendering cultivation of lands immediately along the banks impracticable, but the edge of the cultivated lands on either side is not more than one-fourth of a mile from the river bank; 4,000 bales of cotton and 40,000 sacks of seed are produced in an ordinary season from its mouth to the Ivanhoe Bridge. Most of this cotton and cotton-seed is either hauled a great distance to Port Gibson or Vicksburg at a considerable expense, or disposed of near home at a sacrifice.

Farther up the river the lands are not so low, more productive, and in a higher state of cultivation. There is no question but that if the river was thoroughly improved in the manner heretofore pursued, the Big Black River would rapidly develop in commercial importance. About 100,000 overcup oak staves are taken out of the river every year.

The amount of work done during the season was as follows:

Months.	Number of trees cut.	Number of snags cut.	Number of logs cut.	Number of rock heaps destry ed.	Number of trees deadened.	Number of stumps cut.	Number of miles advanced.
1884.							
October	3,780	529	302	12	.....	.....	21¾
November	5,195	757	637	16	.....	.....	21½
December	5,305	159	429	19	.....	.....	12¾
1885.							
January	3,495	138	26	.....	.....	.....	9¼
February	2,758	208	531	1	1,511	695	7¾
March	454	.....	138	.....	2,233	.....	2¼
Total	20,987	1,791	2,063	48	3,744	695	75¼

Very respectfully, your obedient servant,

W. PORTERFIELD,
Assistant Engineer.

Capt. ERIC BERGLAND,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

No reliable commercial statistics could be obtained, but the valley of the river is very fertile, and it is estimated that about 4,000 bales of cotton and 40,000 sacks of seed are annually produced in an ordinary season along that portion of the stream on which work was done during the past season. About 100,000 oak staves are shipped out by the river every year by means of flat-boats.

U 19.

IMPROVEMENT OF BIG HATCHEE RIVER, TENNESSEE.

This river has its source in Northeastern Mississippi, flows in a northwesterly and then westerly direction, and enters the Mississippi River at the junction of Lauderdale and Tipton counties, Tennessee, about 50 miles by river above Memphis, Tenn. It flows through the richest and most productive region of West Tennessee, and its opening to navigation will greatly promote the agricultural and commercial interests of that section, and furnish an additional outlet for transportation of products to market at greatly reduced cost.

An examination of the stream was made by the United States in 1879. The project for its improvement consisted in the removal of logs, snags, leaning timber, &c., obstructing navigation from Bolivar, Tenn., to the mouth, a distance estimated at 240 miles. The removal of these obstructions would probably render the river navigable for light-draught boats throughout the year. The estimated cost of this improvement was $30,000.

The work heretofore done in this stream was begun in 1880 and continued during 1881 and 1882. Before the commencement of the work navigation of the river was almost impossible. The work done up to 1882 had resulted in a benefit to commerce by allowing the shipment of

products by river, whereas before that time the railroads had a monopoly of the carrying trade. The work done during the past season was carried on under the superintendence of Mr. John J. Barry, whose report thereon is submitted herewith. The working party was transferred from South Forked Deer River, and operations were begun December 14, 1884, at Piljerk's Landing and continued up-stream to 8 miles above Locust Bluff, a distance of 50 miles. On February 10, 1885, the water having reached a stage too high to continue advantageous work, the force was discharged, having removed the following obstructions:

Leaning trees cut	1,094
Trees girdled	1,266
Stumps cut	411
Logs removed from channel	420
Snags removed from channel	138

Although the improvement cannot be called permanent, yet it is thought that this portion of the river will not require attention for some years, or until other portions of the river where work is greatly needed have been cleared of obstructions.

With the small balance available and the amount asked for the fiscal year ending June 30, 1887, it is proposed to continue the removal of channel and bank obstructions as heretofore.

The following appropriations have been made for this work:

By act approved June 14, 1880	$10,000 00
By act approved March 3, 1881	3,500 00
By act passed August 2, 1882	3,000 00
By act approved July 5, 1884	2,500 00
Amount expended to June 30, 1885	18,211 01

Money statement.

July 1, 1884, amount available		$247 19
Amount appropriated by act approved July 5, 1884		2,500 00
		2,747 19
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$1,940 20	
July 1, 1885, outstanding liabilities	18 00	
		1,958 20
July 1, 1885, amount available		788 99
Amount (estimated) required for completion of existing project		11,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		11,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		

REPORT OF MR. JOHN J. BARRY, SUPERINTENDENT.

VICKSBURG, MISS., *February* 14, 1885.

CAPTAIN: Under instructions from you I transferred my outfit on the 7th day of December, 1884, from South Forked Deer River, Tennessee, to Big Hatchee River, Tennessee, arriving there on the 14th day of December, 1884, and commenced operations which consisted in the removal of leaning trees, logs, snags, and other obstructions. The work was continued up-stream from Piljerk's Landing to 8 miles above Locust Bluff, a distance of 50 miles, when, on account of high water, caused by heavy rains, I was instructed by you to discontinue operations, as work could not be done to advantage, or on an economical basis, and to store my outfit in proper condition with a responsible party until such time as the water, in your judgment, would permit the successful commencing of operations, which I did on the 10th day of February, 1885. As the time was limited in the progress of the work by high water, there was only a moderate amount of work accomplished.

The following obstructions were destroyed:

Leaning trees cut	1,094
Logs removed from channel	420
Stumps cut	411
Snags removed from channel	138
Trees girdled	1,266

The river flows in a northwesterly direction from Bolivar, Tenn., passing through the following counties: Hardeman, Haywood, Tipton, and Lauderdale, all of which are inhabited by a prosperous and industrious people.

The river is crooked, but wide; has a good average depth of water, and, were the channel obstructions thoroughly removed, there is no reason why small steamers should not navigate it all the year. At present it is navigated by the steamers P. H. Kelly and C. Schurz, one in the interest of the Bluff City Cooperage Manufacturing Company and the other in the general commerce of the surrounding country. Other boats and tugs make various trips, with different interests, as high as Boli Tenn., which is the head of navigation. It has several saw-mills along its banks, and millions of feet of timber are cut and rafted yearly to the market at Memphis, Tenn., There are about 400,000 staves along its banks awaiting shipment, and also vast quantities of timber cribbed and ready for rafting this season. The timber consists of oak, cypress, hickory, gum, walnut, and poplar. There are also some 200,000 cooperage staves and 10,000 cords of heading, which are to be carried by steamboats to Memphis, and there used in the cooperage manufactory.

Its principal towns are Rialto, Tenn., and Bolivar, Tenn. It has many landings, but the towns, as a general thing, are back from the river a short distance. The river requires to be worked during low water only, and can be put in good navigable condition with a moderate amount of labor, its width and rapid current preventing the formation of any jams. Should the work be continued next season, I would respectfully suggest that it be commenced at Rialto Bridge and continued up-stream until Bolivar is reached, removing principally the channel obstructions, as they are most in the way, from the mouth to the head of navigation.

The bridges of the Louisville and Nashville and Chesapeake, Ohio, and Southwestern railroads cross the river below Bolivar, both having draws.

Very respectfully, your obedient servant,

JNO. F. BARRY,
Superintendent.

Capt. ERIC BERGLAND,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

Two steamboats ply in this stream, and other boats and tugs ascend as high as Bolivar, Tenn., at various times. Reliable commercial statistics could not be obtained, but the following are approximately correct:

Cotton	bales..	11,000
Cotton-seed	sacks..	35,000
Lumber	feet..	500,000
Staves	number..	650,000
Heading	cords..	10,000
Cattle, sheep, &c., estimated value		$150,000

With a considerable quantity of return freights.

U 20.

IMPROVEMENT OF SOUTH FORKED DEER RIVER, TENNESSEE.

This river heads in McNairy and Henderson counties, Tennessee, and, flowing in a general northwesterly direction, joins the main Forked Deer River about 8 miles below Dyersburg, Tenn., and is the most important of all branches that form that stream.

The commerce of the country through which the stream passes is considerable, and was, before the introduction of railroads, carried upon this stream to the Mississippi River. Of late years, however, the rail-

roads have diverted the transportation of a large portion of products in other directions. Two railroad bridges and five county bridges, all without draws; a log boom at Hosier Mill, about 100 miles above the mouth, and a brush dam, 13 miles below Bell's Depot, Tenn., and about 130 miles above the mouth, which deflects the main body of the river into an artificial channel for the use of private parties, all form serious obstructions to the navigation of this river. Owing to these obstructions the navigation is principally by means of flat-boats that can pass under the bridges.

An examination of the river was made by the United States in 1880, and the project for the improvement consisted in the removal of snags, logs, leaning timber, and similar obstructions to navigation, at an estimated cost of $19,250. The original plan only contemplated improving the river from Sharon, Tenn., to the mouth, about 114 miles, but work has been carried up to Jackson, Tenn., the head of navigation, 81 miles above Sharon, and will probably increase the estimated cost of the work. The only work heretofore done was carried on during 1883. A large number of obstructions, principally overhanging timber, were removed from the mouth to Jackson, which greatly increased facilities for navigation.

During the past season the work was continued under the superintendence of Mr. John J. Barry, whose report is submitted herewith. Operations were begun at Jackson, Tenn., October 1, 1884, and continued down-stream to Bell's Depot, Tenn., about 60 miles by water, when, the available funds being exhausted, the working party was transferred to the Big Hatchee River, Tennessee, December 17, 1884.

The following obstructions were removed during the season:

Leaning trees cut from banks	1,046
Logs removed from channel	1,852
Stumps cut	867
Snags removed from channel	967
Trees girdled	1,676

In consequence of last season's work a tolerably unobstructed channel has been secured from Jackson to Bell's Depot, and this portion of the river is now navigated by a small steamer which has recently been built at the former place. As long as the artificial obstructions remain the whole river cannot be made navigable for steamboats, but the portion below the lower obstruction, extending about 100 miles above the mouth, and the reach from Bell's Depot to Jackson can be improved in the interests of steamboat navigation.

Should an appropriation be made for the fiscal year ending June 30, 1887, it is proposed to continue the removal of obstructions from the channel and banks as heretofore.

The following appropriations have been made for this work:

By act passed August 2, 1882	$3,000
By act approved July 5, 1884	2,000
Amount expended to June 30, 1885	5,000

Money statement.

Amount appropriated by act approved July 5, 1884	$2,000	00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	2,000	00
Amount (estimated) required for completion of existing project	14,250	00
Amount than cat be profitably expended in fiscal year ending June 30, 1887	5,000	00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

REPORT OF MR. JOHN J. BARRY, SUPERINTENDENT.

VICKSBURG, MISS., *February* 14, 1885.

CAPTAIN: Under instructions from you, I left Memphis, Tenn., on the 27th day of September, 1884, to commence operations on the South Fork of Forked Deer River, arriving at Jackson, Tenn., on the 28th.

I transferred my outfit from the railroad depot, and commenced operations on the 1st day of October, 1884, camping 4 miles below Jackson, Tenn., and putting the outfit of tools,&c., in proper condition, and then worked up-stream a distance of 5 miles, to what is known as the old McClanahan Landing, the head of navigation, and then down the river a distance of about 60 miles by water to Bell's Depot, when, under instructions from you, I transferred my outfit and crew, on the 7th day of December, 1884, to Big Hatchee River, Tennessee. The work consisted in the removal of leaning trees, logs, snags, &c., and also a vast amount of minor obstructions, such as elbow brush, willow brush, &c., of which no record was kept, but the removal of which was as necessary, in the interest of safe navigation, as the larger ones. These small obstructions are found principally on sharp points, which have to be cut back so that in high water steamers can pass over them, as the turning of sharp points in narrow streams of this nature is a constant trouble to steamers.

The following obstructions were destroyed:

Leaning trees cut	1,046
Logs removed from channel	1,852
Stumps cut	867
Snags removed from channel	967
Trees girdled	1,676

Two rack heaps, 75 feet by 75 feet each.

The river is very crooked. It is moderate in width, which makes it more subject to obstructions than those that are wider, and requires the close removal of all leaning trees, logs, snags, and channel obstructions of all kinds. It has a moderate depth of water, from 3 to 4 feet, with the channel running near one bank or the other. It flows in a northwesterly direction from Jackson, passing through the counties of Madison, Haywood, Crockett, Lauderdale, and Dyer, being about 200 miles in length from Jackson to the mouth, and empties into the north fork of Forked Deer River, 8 miles below Dyersburg, Tenn., and finds its way into the Mississippi at Hale's Point, 95 miles above Memphis, Tenn.

Its tributaries are small creeks or bayous, and are all unnavigable, but are principally used as float-roads for timber. This river has the advantage of many larger streams in having sharp points but large bends, thus making it easy for moderate-size steamers to navigate with safety were the obstructions thoroughly removed. The peculiar nature of the stream, its rapid current in high water, and its contracted scouring propensities prevent the accumulation of drift-racks which we found to be the case, as none had accumulated during last season after the previous season's cutting, except where the trees had caved from the banks and formed an obstruction which could not be moved by the current, as they had jammed themselves between both banks.

There is a brush dam below Bell's Depot, built by parties for private purposes. It is composed of miniature brush pilings, and its object is to divert the water from the main channel into a mill-race. It is a complete obstruction to navigation, and has been for years. There are various other obstructions, such as county and railroad bridges having no draws, which virtually close navigation as far as steamboats are concerned.

The interests of open and free navigation demand that these obstructions should be removed or put in proper shape for steamers to pass them with safety.

The river, from Bell's Depot down-stream for a distance of 20 miles has never had any work done upon it, it having been left, under instructions from Maj. A. M. Miller, on account of lack of funds. This 20 miles is the dividing link between the cut or improved portions of the river, and is one of the worst obstructed portions of the river, the leaning timber lapping from one bank to the other. It is also full of logs, snags, &c., caused by the sluggishness of the water, which has no current on account of the brush dam diverting the water from the channel, thus taking away the scouring power by removing the body of water that should pass that way. Until this 20 miles is opened navigation, at even a moderate stage of water, is virtually suspended. The timber along the banks is one of the principal features that would add to the wealth of that portion of the country, had it the proper advantages of transportation. It consists of oak, cypress, poplar, walnut, hickory, and ash, and with free navigation to the outside world would, to a great extent, be the commercial life to the surrounding country. On the banks of the river at present are some 600,000 staves, which will find their market at New Orleans and from there to other countries. These staves are worth from $65 to $75 per 1,000 laid on the banks of the river, and

from $100 to $150 per 1,000 at New Orleans. This shows the financial standing of the timber interest. Ten boats left last season loaded with staves, and about the same number will leave this season. The boats have an average length of 120 feet, with a 22-foot beam, and draw, when loaded, from 5 to 7 feet of water. They are brought out in high water, but boats of smaller dimensions could navigate in low water were the river put in proper condition.

There are several saw-mills along the banks, at Hosier, Clay Bluff, Sutton's Landing, Chestnut Bluff, and other points that raft and saw yearly millions of feet of lumber, which finds its market principally by rail. The proper opening of the river would make cheaper and quicker transportation, add to the health of the bottom country by assisting the drainage, prevent a monopoly of freights by railroad companies, and give the people a choice of market for their productions.

The commercial standing is estimated by the amount handled at various points, as follows:

	Bales.
Jackson, cotton	15,000
Bell's Depot, cotton	8,000
Chestnut Bluff, cotton	2,000
Poplar Corner, cotton	1,000
Clay Bluff, cotton	500
Foltz's Station, cotton	500
Total	27,000

Staves	number..	600,000
Cotton seed	sacks..	19,000
Cattle and produce, estimated value		$500,000

. The up-freights come by various ways and cannot be estimated.

Should the work be continued next season I would respectfully suggest that operations be commenced at Bell's Depot, removing the brush dam and opening the 20 miles of river below, the work to proceed down-stream until the mouth is reached, and then building a flat-boat with a steam capstan at Jackson, to remove the obstructions that could not be removed by hand power.

Very respectfully, your obedient servant,

JNO. J. BARRY,
Superintendent.

Capt. ERIC BERGLAND,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

The commerce of the river at present is carried on during high water principally by flat-boats drawing from 5 to 7 feet of water. No reliable commercial statistics could be obtained, but the following quantities, estimated by the amounts handled at the principal points on the river, shows the commercial standing of the country bordering the stream:

Cotton	bales..	27,000
Cotton-seed	sacks..	19,000
Staves	number..	600,000
Cattle and produce, estimated value		$500,000

Also a large amount of lumber and return freights, the quantity or value of which could not be estimated from the data obtained.

U 21.

WATER-GAUGES ON THE MISSISSIPPI RIVER AND ITS PRINCIPAL TRIBUTARIES.

By joint resolution of Congress, approved February 21, 1871, the Secretary of War was directed "to have water-gauges established and daily observations made of the rise and fall of the Lower Mississippi River and its chief tributaries at or in vicinity of" certain specified points.

During the fiscal year daily observations have been made at the following stations:

Alexandria, La., on Red River; Baton Rouge, La., on Mississippi River; Cairo, Ill., at junction of Mississippi and Ohio rivers; Carrollton,

La., on Mississippi River; Florence, Ala., on Tennessee River; Fort Leavenworth, Kans., on Missouri River; Helena, Ark., on Mississippi River; Jacksonport, Ark., on White River; Lake Providence, La., on Mississippi River; Little Rock, Ark., on Arkansas River; Louisville (upper), Ky., on Ohio River; Louisville (lower), Ky., on Ohio River; Memphis, Tenn., on Mississippi River; mouth of White River, Ark., on Mississippi River; Nashville, Tenn., on Cumberland River; Natchez, Miss., on Mississippi River; Red River Landing, La., on Mississippi River; Saint Louis, Mo., on Mississippi River; Vicksburg, Miss., on Mississippi River.

These gauges were established by Maj. W. E. Merrill, Corps of Engineers, United States Army, during the latter part of 1871, except those at Carrollton, La., established January, 1872, and at Nashville, Tenn., August, 1873.

Regular observations were commenced at each station as soon as the gauge was established, and continued regularly since, so that a complete record of daily readings at all the stations (with a few exceptions) has been obtained from January, 1872, to the present time. In 1881 bulletin boards were erected at all stations on the Mississippi, for the purpose of giving to steamboats the stage of water each morning. Under my direction the gauges at Baton Rouge, Carrollton, Memphis, Natchez, and Vicksburg were inspected, repaired, and tested. In addition to the above the Mississippi River Commission has inspected the gauges on the Mississippi River nearly every month, and made the necessary repairs. Records of the daily readings of the gauges have been furnished the Mississippi River Commission, and a copy of the Carrollton gauge record has been furnished the assistant engineer in local charge of the examination and survey of the South Pass of the Mississippi River. Hydrographs of all the gauges were made but retained in this office. Copies of the gauge records at all the stations are transmitted herewith. In accordance with the joint resolution approved February 21, 1871, referred to above, the sum of $5,000 was to be appropriated annually for the gauges. As no appropriation was made for the next fiscal year, and the amount available at the end of this fiscal year would not be sufficient to maintain all of the gauges during the following year, the Mississippi River Commission has agreed to pay the observers at the gauge stations on the Mississippi River in order to prevent the suspension of those important observations. The readings of the gauges on the tributaries will be continued during the fiscal year, or until the appropriation is exhausted.

Money statement.

July 1, 1884, amount available	$754	53
Amount appropriated by act approved July 5, 1884	5,000	00
	5,754	53
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	3,637	00
July 1, 1885, amount available	2,117	53
Amount that can be profitably expended in fiscal year ending June 30, 1887	5,000	00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

Comparison of flood of 1885 *with highest water previously recorded at the different stations.*

Stations.	Highest water previously recorded.		Highest water of 1885 to June 30.		Relation to previous highest record.
	Year.	Gauge reading.	Date.	Gauge reading.	Below.
		Feet.		*Feet.*	*Feet.*
Cairo	1883	52.17	January 26	39.00	13.17
Memphis	1882	35.15	January 28	29.25	5.90
Helena	1882	47.20	January 30	40.70	6.50
Mouth of White River	1882	48.40	January 23, 24, 25	43.60	4.80
Lake Providence	1862	40.87	May 9, 10, 11	35.55	5.32
Vicksburg	1862	51.10	February 3	42.40	8.70
Natchez	1862	50.30	February 3, 4, 5	42.60	7.70
Red River Landing	1882	48.50	February 5, 6	41.96	6.54
Baton Rouge	1884	36.20	January 30, 31.. February 2	31.90	4.30
Carrollton	1862	15.90	January 24	13.65	2.25
Saint Louis	1844	41.39	June 17	27.10	14.29
Louisville (upper)	1884	46.60	January 21	21.70	24.90
Louisville (lower)	1884	72.00	January 21	47.00	25.00
Fort Leavenworth	1881	26.75	June 19	18.20	8.55
Nashville	1882	55.30	January 21	37.80	17.50
Florence	1867	31.08	January 20	17.80	13.28
Jacksonport	1867	32.83	January 2	30.90	1.93
Little Rock	1857	31.00	April 27, 28, 29	28.60	2.40
Alexandria	1866	36.46	January 25	34.30	2.16

U 22.

PRELIMINARY EXAMINATION OF CASSIDY'S BAYOU, MISSISSIPPI.

UNITED STATES ENGINEER OFFICE,
Vicksburg, Miss., December 10, 1884.

SIR: I have the honor to submit the following report upon the preliminary examination of Cassidy's Bayou, Mississippi, made in accordance with the requirements of the river and harbor act of July 5, 1884.

The examination was made by Assistant Engineer S. S. Burrowes, whose report is submitted herewith.

From his report it will be seen that the bayou above the mouth of Hopson's Bayou is evidently not worthy of improvement.

His estimate for the improvement of the bayou below this point, a distance of about 44 miles, is $8,000, or nearly $200 per mile. The commerce to be benefited is estimated at 2,100 bales of cotton and about 1,000 tons of cotton-seed, together with an indefinite amount of return freight.

Even though the production may be doubled in a few years if the country be protected from overflow, yet a considerable portion will be annually marketed before there is sufficient water in the bayou to permit steamers to enter.

For these reasons I am of the opinion that Cassidy's Bayou is not worthy of improvement.

No further survey is considered necessary.

Very respectfully, your obedient servant,

ERIC BERGLAND,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

REPORT OF MR. F. S. BURROWES, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Vicksburg, Miss., December 6, 1884.

CAPTAIN: I have the honor to submit the following report on an examination of Cassidy's Bayou, Mississippi, made under your direction, to determine its availability for purposes of navigation:

I proceeded from this point to Clarksdale by rail and thence across to the bayou by road. It was found necessary to make the whole of the inspection on foot, as only for short distances was there sufficient water in the bayou with a channel free enough from obstructions to allow the use of a skiff. The water in the bayou at the time of the examination was near its lowest stage

CASSIDY'S BAYOU.

Cassidy's Bayou starts out from Moore's Bayou about 8 miles from the point where that stream enters the Coldwater River; it flows thence westerly, and gradually bending to the left until its general direction is a little east of south, enters the Tallahatchee River opposite Sharkey Landing, the highest point on that river to which boats make regular trips throughout the year. The bayou has a total (estimated) length of 80 miles, is very tortuous throughout, and runs through parts of Coahoma, Quitman, and Tallahatchee counties. The bed and banks are composed of clay and sand, covered with a thick layer of black buckshot soil.

TRIBUTARIES.

Ox-Bow, Kay, Melancholy, and Hopson's bayous are the only true tributaries to Cassidy's Bayou. Of these Hopson's is the only one which discharges water the year round, the others being dry at low water. During the rainy season they all contribute largely to the amount of water in the bayou, but at a medium stage the principal supply is drawn from the Coldwater River. At such time the direction of the current in Moore's Bayou, between Cassidy's Bayou and the Coldwater River, which at low water flows towards the Coldwater, is reversed, and Cassidy's and the lower part of Moore's Bayou is converted into a side chute of the Coldwater and Tallahatchee rivers.

THE UPPER BAYOU.

From its head to the mouth of Kay Bayou, a distance of 18 miles, the channel of Cassidy's Bayou has a very wide and shallow cross-section, the banks varying in height from 5 to 12 feet. In many places there are no well-defined banks, the bayou at such points being nothing more than a depression in the swamp. The whole of this portion of the bayou is grown up with timber and cypress trees, and is, in fact, little else than a cypress brake, slightly lower than the surrounding country.

BIG CREEK.

Immediately below the mouth of Kay Bayou the channel widens out into a lake having a width of 150 feet, a depth of from 10 to 15 feet, and banks 12 feet in height. It preserves this character, with a width varying from 75 to 150 feet, for a distance of 7 miles, the banks being lined most of the way with heavy timber. This is known as Big Creek, and is nearly free from obstructions, there being only a few logs and drift-piles to be removed and leaning trees to be cut in order to allow the passage of large boats. This part of the bayou could easily be made navigable, but it would remain inaccessible to steamers, as the stretch below, extending to the mouth of Hopson's Bayou (a distance of 11 miles) is of the same character as that above Kay Bayou; that is to say, little more than a densely-timbered cypress brake, through which there is no well-defined channel. In fact, the whole of Cassidy's Bayou above the mouth of Hopson's Bayou is entirely unworthy of consideration as a navigable stream.

The commerce of this part of the bayou amounts to 500 or 600 bales of cotton a year, grown on plantations scattered along its entire length. A sufficient outlet for this trade is furnished by hauling from 6 to 15 miles to points on the railroads.

The only town on Cassidy's Bayou is New Belen, the county seat of Quitman County. It is situated immediately at the head of the bayou, on the left bank, and consists of a frame court-house, log jail, one dwelling, and a store.

FROM HOPSON'S BAYOU TO THE MOUTH.

Hopson's Bayou at all times discharges a considerable quantity of water into Cassidy's Bayou. Below its mouth the banks are higher and the channel better defined, and not so completely closed by logs, snags, trees, and other obstructions as above.

The following table gives distances, widths, &c., along this portion of the bayou. The number of bales of cotton given as produced annually includes all the cotton raised in the immediate vicinity of the different points named, and which would naturally seek the bayou as an outlet if it were made navigable.

Place.	Bank.	Distance.	Low-water width.	Low-water depth.	Cotton produced annually.	Remarks.
		Miles.	*Feet.*	*Feet.*	*Bales.*	
Month	.....	.....	70	4	.....	Opposite Sharkey Landing.
Robinson Place	Right...	8	70	4	300	
Jennings Place	Left	14	50	3	250	
Webb Place	Right...	16	60	3	350	Hood's post-office.
Winston Place	Left	20	40	2½	250	
Jenkins Place	Right...	24	40	2½	100	
Friarson Place	....do ...	29	30	3	200	
Buford Place	....do ...	35	40	2	200	
Magee Place	....do ...	39	30	2	150	
Starns Place	....do ...	44	25	1½	300	Mouth of Hopson's Bayou.
Total	.....	.....	.....	.....	2,100	

Along this portion of the bayou the banks are stable, and from 20 to 25 feet in height. They have a very flat slope from the edge of low water to the top, making the top width from 200 to 500 feet. Throughout almost the entire distance this slope is covered with heavy timber, principally cypress, oak, and ash. The country along the right bank is cleared and cultivated for about one-half of the distance. On the left bank there is only a small portion opened for cultivation, the balance remaining heavily timbered. The channel is only from 40 to 75 feet wide between the timber, and is obstructed by numerous snags, logs, stumps, drift-piles, and leaning trees.

FLOODS.

During the past three high-water seasons, that is, 1882, 1883, and 1884, the Cassidy's Bayou country has been almost completely overflowed to depths varying from 2 to 5 feet, only a few small ridges and high places remaining above water. These overflows were caused by the water from the Mississippi River escaping through the numerous gaps in the levees and pouring over this country.

If these crevasses are closed, there is no danger to be apprehended either from the water carried by the Coldwater and Tallahatchee rivers or that backed up through the mouth of the Yazoo. The effect of these inundations has been disastrous in the extreme, as they have not only caused much suffering and direct loss of stock and buildings, but the fear of their recurrence has driven a large part of the labor from the country to the less productive but more secure hill lands. For this latter reason a large part of the cleared land is at present uncultivated and unproductive, the indirect loss from which is very great. It is to be hoped that the efforts at present being made to resist the floods of the Mississippi with an unbroken and effective line of levees may be successful, and the rich and productive lands along Cassidy's Bayou thereby fully reclaimed.

NAVIGATION.

Cassidy's Bayou, below the mouth of Hopson's Bayou, has been navigated for many years by very small steamboats during high water; that is, from February to June. The accumulation of obstructions has, however, caused the number of trips made to gradually decrease, until at present the steamboat traffic of the bayou is of very limited extent. The stream is now almost exclusively used for carrying purposes by flatboats propelled with poles. As many of the planters own their own boats, they have found this an economical, if not expeditious, mode of transporting their cotton to the Tallahatchee River, whence it is shipped by steamboat to market.

COST OF IMPROVEMENT.

The only improvement of Cassidy's Bayou which is worth considering is the removal, below the mouth of Hopson's Bayou, of all logs, snags, stumps, and drift-piles from the channel, and the cutting and removal of all standing timber on the

slope of the banks, so as to give an unobstructed width of 150 feet on the reaches and 200 feet in the bends. This would make navigation practicable for a period three or four months longer than at present, and at all times much less hazardous. It is estimated that such improvement could be accomplished for the sum of $8,000.

ADVISABILITY OF IMPROVEMENT.

The improvement of Cassidy's Bayou, above the mouth of Hopson's Bayou, is, as before stated, regarded as impracticable, on account of the numerous obstructions and general inadequacy of the channel, and unnecessary, as the small amount of cotton raised has a sufficiently available outlet by roads and railroads.

Below the mouth of Hopson's Bayou the stream could be made navigable for seven or eight months in the year, and the traffic would, in a short time, no doubt be sufficiently increased thereby to justify the expenditure of the amount estimated.

The present amount of cotton annually raised along this portion of the bayou is 2,100 bales, which, with 1,000 tons of seed, and the necessary supplies as return freight, constitutes the entire commerce of the country. Were the country freed from overflows this amount would, no doubt, soon be increased to 3,000 or 4,000 bales annually produced. The whole of this would seldom, however, be tributary to the bayou, as the water never reaches a navigable stage until January or February, and as, on account of the peculiar conditions under which much of the planting is carried on, the crop must be marketed as soon as gathered, a part of it would be hauled to points on the railroad before boats could possibly ascend the bayou.

The saving effected by shipping by steamboat over hauling in wagons is at least 25 cents per bale, which would amount to $500 on an annual shipment of 2,000 bales. Were the bayou improved the rates would, no doubt, be so reduced as to make the saving as much more.

I was unable to get any definite information as to the cost of transportation by flatboats, but, as under the present conditions they have been found to be successful competitors of the steamboats, it has evidently been the cheapest mode of shipment. Another beneficial result of the improvement would be to make profitable the sale of cotton-seed, most of which is at present either fed to stock or used as a fertilizer. The saving on return freight can be assumed as equal to that on cotton shipped, making a total of at least $2,000 annually saved to the planters on Cassidy's Bayou, were it improved so as to give free and safe navigation during seven or eight months in the year.

Very respectfully, your obedient servant,

F. S. BURROWES,
Assistant Engineer.

Capt. ERIC BERGLAND,
Corps of Engineers.

U 23.

PRELIMINARY EXAMINATION FOR A LOCK AT YAZOO PASS, MISSISSIPPI.

UNITED STATES ENGINEER OFFICE,
Vicksburg, Miss., December 15, 1884.

SIR: I have the honor to submit the following report upon the "Yazoo Pass, Mississippi, to determine the cost of a lock at that place," in accordance with the river and harbor act of July 5, 1884:

An examination having been made in November, 1882, under direction of Maj. A. M. Miller, Corps of Engineers, and a report having been published in Senate Ex. Doc. No. 30, Forty-eighth Congress, first session, pages 69 to 71, and Appendix S 21, Annual Report of Chief of Engineers, 1884, no further examination is considered necessary, as the pass is now in about the same condition as when previously examined.

Your attention is respectfully invited to the following extract from Major Miller's report, and to the detailed report of Assistant Engineer Thomas M. Farrell, which accompanies the former:

Yazoo Pass, Mississippi, is a bayou and lake—Moon Lake—formerly connecting the waters of the Mississippi near Delta, Miss., with the Yazoo River, through the Coldwater River, Mississippi.

The pass has been closed since 1871 by a levee, and no boats have since navigated the pass.

The examination was made by Mr. Thomas M. Farrell, assistant engineer, whose report is inclosed herewith, in November, during low water.

The commerce to be benefited by a lock into the Mississippi is very insignificant in comparison to the cost of such a work, and, in addition to the building of a lock, a considerable sum would be required to clear the pass through to the Coldwater River.

No estimate of the cost of a lock is given, as this cannot be submitted without an accurate survey. The cost of clearing the pass from Moon Lake to the Coldwater River is estimated at about $8,000.

In view of the above facts, in my judgment, the stream is not worthy of improvement, nor the work a public necessity.

In addition to the railroad to Glendale, mentioned in Mr. Farrell's report, there is now in operation the Louisville, New Orleans and Texas Railroad, giving ample facilities for transportation to Memphis. This road crosses the pass on a pile trestle bridge, which forms an additional obstruction to navigation.

The difference between high and low water in the Mississippi at this point is about 46 feet, and the bed of the pass is 14 feet above low water in the Mississippi. There being no supply of water to the pass except from the Mississippi, through the breaks in the levee above, it could not be made navigable more than half the year.

A lock would be a constant menace to the safety of the levee, unless built with great care, at an enormous cost.

The commerce to be benefited is too insignificant to justify this expenditure, and, in my judgment, the stream is not worthy of improvement.

No survey is considered necessary.

Very respectfully, your obedient servant,

ERIC BERGLAND,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

U 24.

PRELIMINARY EXAMINATION OF DEER CREEK, MISSISSIPPI.

UNITED STATES ENGINEER OFFICE,
Vicksburg, Miss., December 10, 1884.

SIR: I have the honor to submit the following report upon the preliminary examination of Deer Creek, Mississippi, made in accordance with the requirements of the river and harbor act of July 5, 1884:

Deer Creek has its source in Lake Bolivar, in Bolivar County, and flows thence in a southerly direction through Washington, Sharkey, and parts of Issaquena and Warren counties, and empties into the Yazoo River 25 miles above the mouth of the latter. Deer Creek has two other outlets in addition to its mouth proper. The main outlet is the Rolling Fork, which leaves Deer Creek at the town of Rolling Fork, runs into Little Sunflower River, and thence through Indian Chute into Big Sunflower River. The portion above Rolling Fork to Stoneville, which is considered the head of navigation, is called Upper or Big Deer Creek. The other outlet is through Black Bayou, which runs westwardly and connects Deer Creek with Steele's Bayou.

The portion between Rolling Fork and Black Bayou is known as

Lower Deer Creek, and that below Black Bayou is called Little Deer Creek.

Upper Deer Creek varies in width from 100 to 200 feet. This, together with the Rolling Fork, forms the most important section of the river. It flows through a rich alluvial valley, which is cultivated on both sides all the way up to Stoneville, and produces annually about 43,000 bales of cotton and 25,000 tons of cotton-seed for export, besides corn enough for home consumption.

Most of this cotton is now sent to market by the Louisville, New Orleans and Texas Railway, which crosses this section at Rolling Fork and again at Nittayuma, some 20 miles above the former place. The obstructions to navigation consist of logs, stumps, and fallen trees in the channel, and overhanging trees on the banks. Were these removed, navigation of this section would be possible during seven or eight months of the year, and much of the cotton and cotton-seed would probably be sent down to the Mississippi River by water at a considerable saving of freight.

Even if the competition with the railroad effected a reduction of only 50 cents per bale, the planters would save annually on cotton alone about $22,000.

As both banks of this portion of the river are cleared and under cultivation, the obstructions, after having been once thoroughly removed, would not soon reform, and the improvement would not have to be repeated each year, as is the case where the caving banks are covered with timber. One fixed railroad bridge and more than fifteen highway bridges now form artificial obstructions to free navigation. Until these are altered or removed, the removal of the natural obstructions would be of little service to navigation.

For the reasons above given, I consider that Deer Creek, from Leland down to the mouth of Rolling Fork, is worthy of improvement, provided the artificial obstructions above referred to be removed. The portion of the river below Rolling Fork is of less importance. The country through which it flows is not so highly cultivated, the obstructions are more numerous, and the channel depth and width are less than in the upper section; the amount of cotton raised is only about 7,000 bales; and the artificial obstructions consist of three fixed railroad bridges, besides a number of highway bridges.

For these reasons I do not consider this section of the river worthy of improvement.

The following estimate is submitted for the improvement of Deer Creek, Mississippi, from the mouth of Rolling Fork to Leland:

Boats and outfit	$1,000
Superintendence and labor, ten months (two seasons)	11,330
Contingencies, 10 per cent	1,233
Total	13,563

No further survey is considered necessary. The examination was made by Assistant Engineer F. S. Burrowes, whose report, giving detailed information concerning the river and its obstructions, character and resources of the adjacent country, and other valuable information, is submitted herewith.

Very respectfully, your obedient servant,

ERIC BERGLAND,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

REPORT OF MR. F. S. BURROWES, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Vicksburg, Miss., November 24, 1884.

CAPTAIN: I have the honor to submit the following report upon an examination of Deer Creek, Mississippi, made under your direction with a view to its improvement:

In obedience to your letter of instructions of the 11th instant, I went by rail from this point to Rolling Fork, at which place I procured a skiff and proceeded thence up the creek as far as Arcola. From Arcola up to Stoneville I made the examination on foot, as the channel was so full of logs and trees as to be almost impassable with a skiff. Returning by rail to Rolling Fork, I examined Lower Deer Creek from that point to its mouth, also on foot, as the stream was practically dry. The stage of water in the creek at the time of the examination was most advantageous for the purpose, being at the lowest point reached for many years, and thus exposing to view all the obstructions.

DEER CREEK.

Deer Creek has its source in Lake Bolivar, and flows thence southwesterly through Bolivar, Washington, Sharkey, and parts of Issaquena and Warren counties, emptying into the Yazoo River 25 miles above its mouth. Its course throughout is through one of the richest sections of the Yazoo Delta. Stoneville, in Washington County, has always been considered the head of navigation, the creek above being so obstructed and so small as to be not worthy of consideration as a navigable stream. The navigation, therefore, was not continued beyond that point.

OUTLETS.

Deer Creek has three outlets, which afford entrances for steamboats, and divide it into three almost distinct navigable streams. The main outlet is the Rolling Fork, which leaves the creek at the town of Rolling Fork, and gives a connection with the Little Sunflower River, and thence through Little Sunflower and Indian Chute with Big Sunflower River. The portion of the creek above Rolling Fork, and as far up as Stoneville, is known as Upper or Big Deer Creek.

The next outlet below is Black Bayou, which connects the creek with Steele's Bayou, a stream at present in process of improvement. The portion of the stream between Rolling Fork and Black Bayou is known as Lower Deer Creek.

The third and least important outlet is what is called the true mouth of the creek, emptying directly into the Yazoo River. The section between the mouth and Black Bayou is known as Little Deer Creek.

UPPER DEER CREEK.

Upper or Big Deer Creek, considered as a navigable stream, should include the Rolling Fork which connects it with the Little Sunflower River, as any plan for its improvement would necessitate the opening of this outlet in order to make the improvement above it available.

The following table, therefore, gives distances and other data as far up as Stoneville, the mouth of the Rolling Fork being taken as the initial point for distance:

Place.	Distance.	Width of channel.		Cotton produced annually.	Bridges.	
		Top.	Bottom.		Road.	Railroad.
	Miles.	*Feet.*	*Feet.*	*Bales.*		
Mouth of Rolling Fork	0	100	20	.....	.....	.....
Town of Rolling Fork	5½	200	100	5,000	1	1
Indian Bayou	9	175	70	2,000	.....	.....
McKinneyville	15	150	50	5,000	1	.....
Nittayuma	20	160	40	2,000	1	1
Panther Burn	25	150	50	4,000	2	.....
Claytonia	36	175	80	5,000	4	.....
Estell	40	175	30	4,000	3	.....
Arcola	46	200	50	6,000	1	.....
Burdette	54	150	40	5,000	3	.....
Leland	63	150	30	2,000	3	1
Stoneville	68	150	20	3,000	1	2
Total	.....	.....	.....	43,000	20	5

From the mouth of Rolling Fork for a distance of 2 miles up-stream the water was from only 6 inches to 1 foot in depth, from 15 to 25 feet wide, and has quite a considerable fall, as indicated by a current of about 2 miles an hour. The bed of the stream is filled with logs and snags and the banks lined with heavy timber, leaving a space between barely sufficient for the passage of small boats at a medium flood-stage of water. For the balance of the distance ($3\frac{1}{2}$ miles) to the town of Rolling Fork the stream widens out from 30 to 50 feet at low water, and has a depth of about 2 feet with a hardly perceptible current. The logs and snags in the bed of the stream are not so numerous, nor is the timber on the banks as much of an obstruction. One road bridge and one railroad bridge cross the Rolling Fork. The railroad bridge is provided with a draw span which gives a clear width of channel of 30 feet. At the town of Rolling Fork Upper Deer Creek has a width of 100 feet, a depth of 8 feet, and has no perceptible current at low water. The banks are 18 feet in height, and are composed of sand and alluvial soil, known as buckshot.

The bed is mostly of clay. The stream continues of this lake-like character as far up as Panther Burn, the width varying from 40 to 100 feet, and the depth gradually decreasing to $2\frac{1}{2}$ feet. At McKinneyville there is a sort of mud shoal, having a depth on it of only $1\frac{1}{2}$ feet, caused by surface soil washing in through a small slough. The banks from the water edge to the top are covered nearly all the way with a heavy growth of timber, mostly willow, cottonwood, and sycamore, with some cypress. The bed of the creek is filled with logs and snags, which increase in size and quantity as the stream is ascended. At Nittayuma there is a fixed railroad bridge built on piles. Four road bridges span the creek in this reach.

From Panther Burn to Arcola the creek changes somewhat in character. It narrows to a general width of 50 feet, and has a general depth of $2\frac{1}{2}$ feet. In several places it is only 20 feet wide and $1\frac{1}{2}$ feet deep. There is a current having a velocity of about 1 mile an hour most of the way. The bed is a complete net-work of logs and large fallen trees, which reach completely across the stream at short intervals. The timber on the banks is heavier and more of an obstruction. In many places trees from either side lean so as to intersect. The timber is, however, confined to the banks, the country adjoining being cleared and cultivated almost the entire distance. The banks are 20 feet in height and of the same nature as those below. Eight road bridges cross this portion of the stream. Above Arcola, and as far up as Stoneville, the creek is sluggish, is from 20 to 30 feet in width, and from $1\frac{1}{2}$ to 2 feet deep, the bed of the stream being clogged with logs and grass. The timber along the banks leans over the narrow channel and completely obstructs navigation. For the greater part of the distance, however, it is light, being mostly willow and cottonwood. There are seven road bridges and three fixed railroad bridges across this portion of the creek, including the bridges immediately at Stoneville.

LOWER AND LITTLE DEER CREEK.

The following table gives distances, widths, &c., along the creek from the Yazoo River to Rolling Fork:

Place.	Distances.	Width of channel.		Cotton produced annually.	Bridges.	
		Top.	Bottom.		Road.	Railroad.
	Miles.	*Feet.*	*Feet.*	*Bales.*		
Mouth	0	250	30	.....	.....	.....
Gibson	5	120	15	600	.....	.....
Hardee	16	125	20	250	.....	.....
Halpin	20	100	15	250	.....	.....
Dixie	24	120	15	500	.....	.....
Kelsoe	29	100	15	500	.....	
Black Bayou	35	130	20	600	2	.....
Watsonia	38	150	40	600	1	.....
Hunt's	44	175	50	1,000	1	.....
Clarke's	49	175	50	1,300	1	1
Egremont	52	150	30	1,500	1	.....
Rolling Fork	59	200	100	.....	2	1
Total	.....	.....	.....	7,100	8	3

At the time of the examination all the water from Upper Deer Creek was flowing out through Rolling Fork, and as the creek below that point has not a single low-water tributary it was found to be, as was to be expected, practically dry. There is one pool of standing water extending from Egremont to Black Bayou, which is one-

half foot deep and from 20 to 30 feet wide. The balance of the stream, including Black Bayou, is absolutely dry, and, if it were not for the mud, could be crossed on foot at any point. From Rolling Fork to Black Bayou the channel is from 20 to 60 feet wide at the bottom, and from 100 to 200 feet wide at the top. There is a large number of logs in the bottom, and leaning timber lines the banks nearly all the way, growing from the top to the bottom. There are eight road bridges and two fixed railroad bridges across this portion of the creek. Black Bayou is 20 feet wide at the bottom, and from 80 to 100 feet wide at the top. The logs and leaning trees in the first mile and a half from Deer Creek are not very numerous, as the bayou passes through cleared land. The remainder of the distance to Steele's Bayou (2 miles) passes through a densely timbered swamp and canebrake, and the channel is filled with obstructions. On the lower half mile an effort has been made by steamboatmen to clear out the stream, and the leaning timber has been cut so as to allow free navigation at high water. There is one road bridge across Black Bayou, near its head. Little Deer Creek, from Black Bayou to Dixie, passes through plantations, and the timber along the bank is almost exclusively light willow. The channel is 20 feet wide at the bottom and 100 feet wide at the top, quite a number of logs being found in the bottom, more or less embedded in the mud. From Dixie to Halpin the channel is of almost the same size, but as it passes through a heavily-timbered country it is almost completely filled with logs and trees and obstructed with leaning timber. Below Halpin's, plantations line the right bank most of the way, and small steamboats navigate the creek for a portion of each year, and have, in the course of time, so cleared away the worst obstructions as to allow of their passage at a medium flood-stage of water. Especially is this noticeable on the first 2 miles above the mouth, the channel being almost entirely clear of obstructions. There still remains, however, a great number of logs to be removed and trees to be cut in order to make anything like safe navigation possible over the upper part of this reach.

CHARACTER OF THE COUNTRY.

As previously stated, the country along Deer Creek is one of the most fertile, highly cultivated, and densely populated sections of the rich bottom lands in the Yazoo delta. The soil is a rich buckshot, and yields large crops. Cotton is, of course, the principal staple, and a bale of cotton, or from 60 to 75 bushels of corn, is the usual return expected from 1 acre. In certain sections over 2 bales of cotton or 100 bushels of corn are sometimes made from an acre. From Stoneville to Rolling Fork there is a strip of cultivated land on either side, varying in width from 1 to 3 miles. Below Rolling Fork, and as far as Black Bayou, this strip is from one-half to 1 mile wide on each side, and below Black Bayou, as far as Dixie, it is one-half mile wide. Below Dixie there are only five large plantations, elevated on the right bank, the balance still remaining uncultivated and uncleared.

BED AND BANKS.

The bed of the stream is composed of sand and clay, and the banks of sand and alluvial deposit. The banks vary in height from 17 to 22 feet, the highest being on the right, along the upper portion of Big Deer Creek.

As in the case with all streams running through an alluvial bottom, the course of the creek in many places is very crooked, sharp turns and long bends being of frequent occurrence. This is more especially noticeable near the mouth, where in several places the distance traversed by the creek is three or four times the length of a straight line between two points of the stream.

OSCILLATION AND FLOODS.

The difference in elevation between extreme high and low water is from 18 to 20 feet on Upper Deer Creek, and increases to 26 or 28 feet at the mouth. The water usually begins to rise in January or February, reaching its highest point in March or April, and continuing high until June or July. Low water prevails during the balance of the year, the lowest occurring generally in October or November. The highest water ever known on the creek was that of 1882, which inundated the entire Deer Creek country from Stoneville to the mouth, with the exception of a small strip along the right bank from Nittayuma northward about 15 miles. At Rolling Fork the water barely covered the creek banks, and the flood there gradually increased in height down the creek, covering the banks at Black Bayou to a depth of 4 feet, and at the mouth to a depth of 8 feet. The succeeding years 1883 and 1884 also brought disastrous floods, neither of which were so high by several feet as that of 1882. Previous to 1882 there is no record of a flood which did serious damage to the Deer Creek country. The cause of this exceptional flood is obvious when we know the

conditions under which it occurred. The levees along the Mississippi River at the upper end of the Yazoo delta, and opposite the headwaters of the Big Sunflower River, during that and the succeeding high-water seasons, were full of gaps, and were in such a generally dilapidated condition as to be of no avail to keep out the flood in the Mississippi, which reached the highest point ever known on that portion of the river during 1882. The water pouring through these openings filled to overflowing the Big Sunflower and Yazoo rivers, and then flowed westward over the Deer Creek country, and this water superadded to the backwater from the Yazoo made the inundation complete. It is not probable that much damage would happen to this section of the country from backwater alone, as when the levees above were practically intact no portion was ever overflowed, except a small area near the mouth. As strenuous efforts are being made to close the gaps in the levees during the present season, it is probable that the Deer Creek country will be freed from such disastrous floods as have occurred for the past three years.

RAILROADS.

The Lonisville, New Orleans and Texas Railroad, running from New Orleans to Memphis, was completed and put in operation during the past summer. This road traverses the Deer Creek country from its mouth to Stoneville, crossing the creek and its outlets six times in that distance. A branch of this road, in process of construction, starts from Leland, and crossing Deer Creek runs thence to a point on the Mississippi River opposite Arkansas City, where it will make a connection with Little Rock, Ark., and the Saint Louis and Iron Mountain Railroad system. Another branch is contemplated starting at Greenville, running thence through the Lake Washington country, and connecting with the main line at Rolling Fork.

A narrow-gauge railroad, known as the Georgia Pacific, from Greenville east, crosses the creek at Stoneville, at which point a branch starts southward and runs close along the right bank of the creek to near the Sharkey County line.

TOWNS.

Stoneville, at the head of navigation, is a small country town having four or five stores and about 150 inhabitants.

Leland is a new town, distant by rail 2 miles from Stoneville. It has been built entirely within the past year, has four or five stores and a hotel, and is as yet of no commercial importance.

Arcola is a small village on the right bank of the creek, contains five or six stores, and is a shipping and supply point for a small section of country.

McKinneyville, on the left bank, is a village of about the same size and importance as Arcola.

Rolling Fork, situated at the intersection of Upper Deer Creek and the Rolling Fork, is the most considerable town on the creek. It contains seven or eight stores, two hotels, saloon, wagon-shop, &c., and has 300 to 400 inhabitants. It is also the county seat of Sharkey County.

COMMERCE.

The Deer Creek country, from Stoneville down, ships during the year some 50,000 bales of cotton, distributed about as given in the tables. This shows about 43,000 bales as the product of the Upper Deer Creek country, and only 7,000 for the balance of the distance. This cotton, with about 25,000 tons of cotton-seed, would constitute the entire outgoing freight, as there is nothing else raised in quantity with a view to shipment. Although large crops of corn can be made, there is seldom more than enough raised to supply the home consumption. In many instances, corn is actually shipped into the country to supply the home demand. The ingoing freight would consist of meat, flour, implements, and other things necessary to make the crops and subsist the inhabitants.

PREVIOUS NAVIGATION.

As stated before, boats have been in the habit of entering the creek in three different ways, the route through Little Sunflower and Rolling Fork, and thence up Big Deer Creek, being the much more important and profitable. Small boats are generally able to make this trip during four or five months in the year, bringing out the cotton and seed and carrying in the necessary supplies. The traffic was carried on mainly with barges, the boats being used only for towing.

Although Stoneville is called the head of navigation, boats have not gone that high up for a number of years. The highest point to which they have been in the habit of going in late years is Burdette's, and most of them have not gone above Arcola.

The navigation through Black Bayou, and thence up Lower Deer Creek, has been very restricted for a number of years back, and generally consists in five or six trips of a small boat during high water.

The steamboat trade of Little Deer Creek has become almost *nil*, except from the mouth to Halpin. Over this portion small boats make frequent trips during the medium high water.

OBSTRUCTIONS.

The only natural obstructions to the navigation of the creek are the logs and trees in the bed of the stream, and the overhanging timber on the banks.

The artificial obstructions are the road and the railroad bridges, which span the creek, and two small wrecks, one of a barge and the other of a small steamboat. Only one of the railroad bridges (the one crossing the Rolling Fork) is supplied with a draw. The remaining seven railroad bridges are fixed structures, built on piles, and should be provided with draws giving a clear span of at least 30 feet, should it be deemed advisable to improve the navigation of the stream.

The road bridges are at present constructed so that the middle span can be taken up, leaving a clear width of 28 or 29 feet, and boats navigating the creek were compelled to remove and replace them at each passage, a proceeding which involved a great deal of labor and expense. In order to give free navigation they should be moved entirely and replaced, if necessary, with ponton bridges or ferries.

PLAN OF IMPROVEMENT.

Any scheme of improvement to make low-water navigation possible would necessarily include some plan for the construction of locks and dams, and perhaps feeders, and would require an accurate and detailed survey to determine the feasibility and probable cost of constructing such works.

The plan of improvement upon which the following estimate is based is for the removal of all logs, stumps, snags, fallen trees, and wrecks from the bed of the stream, and the cutting of all leaning timber on the banks, so as to make navigation possible for seven or eight months in the year, and much less hazardous than at present. If this work were once thoroughly done there would be no further trouble, as the country along both banks, for almost the entire length of the creek, is cleared and cultivated, the only timber being that growing immediately on the banks of the stream. There is no estimate made for the removal of bridges or construction of draw spans, as that expense would naturally fall on the parties owning or controlling such structures.

This work could only be done to advantage during low water, and in Upper Deer Creek a small boat rigged with a crab and shears or other purchase could be used. In Little and Lower Deer Creek the work would have to be done from the shore, as there is not sufficient water to float a boat during the low-water season.

PROBABLE COST OF IMPROVEMENT.

Expenses of party for one month:

Assistant engineer	$125 00
Foreman	60 00
Cook and helper	60 00
20 men, at $30 per month	600 00
Subsisting 24 men, at $12 per month each	288 00
Total	1,133 00

UPPER DEER CREEK FROM STONEVILLE TO MOUTH OF ROLLING FORK.

Estimate.

Boat and outfit	$1,000 00
Ten months' work (two seasons)	11,330 00
Engineering and contingencies, 10 per cent	1,233 00
Total	13,563 00

LOWER DEER CREEK FROM ROLLING FORK TO MOUTH OF BLACK BAYOU.

Estimate.

Outfit	$500 00
Five months' work	5,665 00
Engineering and contingencies, 10 per cent	616 50
Total	6,781 50

LITTLE DEER CREEK FROM BLACK BAYOU TO YAZOO RIVER.

Estimate.

Same as above..... $6,781 50

Total estimated cost of improvement from Stoneville to Yazoo River, including Rolling Fork and Black Bayou, $27,126.

ADVISABILITY OF IMPROVEMENT.

The commerce of the country along Deer Creek, were it all dependent on the streams as the most available means of transportation, would no doubt justify the expenditure of the amount estimated, and might, perhaps, in time render worthy of discussion the question of slackwater navigation. This is now, however, not the case, as the railroads furnish ample means for transporting all the commerce of the country; in fact, this year the probability is that all the cotton will have been shipped before the water is high enough for the boats to run. Whether the railroads will at all times furnish reasonably cheap transportation is not so certain. The only benefit to be derived from the present improvement of the creek would be to give another means of shipment, and to thus afford protection to the planters against extortionate charges by either railroads or steamboats. On Upper Deer Creek, even now, boats will no doubt carry out a large part of the cotton-seed, which, being bulky and expensive to handle, can perhaps be shipped cheaper by water than at ordinary railroad rates.

The estimates given are for the thorough cleaning out of the stream, but a smaller amount could be applied with advantage to the improvement of navigation.

Very respectfully, your obedient servant,

F. S. BURROWES,
Assistant Engineer.

Capt. ERIC BERGLAND,
Corps of Engineers, U. S. A.

U 25.

PRELIMINARY EXAMINATION OF THE OUTLETS OF BŒUF RIVER, LOUISIANA, WITH A VIEW TO CLOSING THE SAME.

UNITED STATES ENGINEER OFFICE,
Vicksburg, Miss., December 6, 1884.

SIR: I have the honor to submit the following report upon a preliminary examination of the "outlets of Bœuf River, Louisiana, with a view to closing the same," as called for by the river and harbor act of July 5, 1884.

These outlets are three in number. The lower and principal one is at Point Jefferson, about 50 miles above Girard, the point where the Vicksburg, Shreveport and Pacific Railroad crosses the Bœuf River. The effects of this outlet are to divert from the river, at all stages, much water which is needed to prolong the navigation of the river, and to form a sand-bar in Bœuf River, opposite and below the outlet, which will eventually cause the entire volume of water to flow into Lake Lafourche. The result of closing it will be to save the navigation of Bœuf River from probably entire destruction, and also to prolong its duration below Point Jefferson.

The two other outlets are on Bonne Idée Bayou, a tributary of the Bœuf at a low stage of water, but which, at high water, acts as an outlet. These latter cause a direct loss of water from the river at certain times, and, at others, an indirect loss, by drawing from the needed supply, which loss will be more apparent when the levees on the Mississippi River, now in process of construction, are completed. Their closure will, therefore, also tend to prolong the navigation of the lower river. Over $14,000 has already been expended by the United States

for the improvement of the navigation of Bœuf River below Point Jefferson, Louisiana.

The commerce of the upper river is now nearly $1,000,000 in value, and the increased duration of navigability would add one-third of that amount. The saving to the people of this section would be 75 cents per bale on about 3,000 bales, which are now shipped by rail, or $2,250 per annum on outgoing, and as much more on incoming freight. In addition, cotton seed to the amount of 5,000 tons, valued at $25,000, which is now annually wasted on account of cost of transportation, would find its way to market.

In my opinion, based upon the facts and reasons above mentioned, the river is worthy of improvement by the closure of the three outlets near Point Jefferson. I would, however, recommend only the closure of the outlets themselves, leaving the connecting levees to be built by parties whose land would be protected thereby, since comparatively no benefit to navigation can result from the levees on the west bank as long as the water escapes from the Bœuf River over the east bank. I therefore submit the following estimate of cost of earth dams, no rock being available:

ESTIMATE.

Dam for Outlet No. 1:	
Slope 2-1, crown 10 feet, 255 feet long. 10,914 cubic yards of earth, at 25 cents	$2,728 50
Dam for Outlet No. 2:	
Slope 1½-1, crown 10 feet, 235 feet long. 9,231 cubic yards, at 20 cents	1,846 20
Dam for Outlet No. 3:	
Slope 1½-1, crown 10 feet, 1,200 feet long. 10,263 cubic yards, at 20 cents	2,052 60
Engineering and contingencies, 10 per cent	662 73
Total	7,290 03

No additional survey is considered necessary. The examination was made by Assistant Engineer Charles Quinn, whose report, with sketch, showing the position and cross-sections of the outlets, and the proposed location of the dams and connecting levees, is forwarded herewith.

Very respectfully, your obedient servant,

ERIC BERGLAND,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

REPORT OF MR. CHARLES QUINN, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Vicksburg, Miss., November 28, 1884.

CAPTAIN: In accordance with your instructions of November 7, 1884, having made an examination of the outlets of Bœuf River, Louisiana, I have the honor of submitting to you the following report:

The southern outlet (or No. 1) flows out of Bœuf River at Point Jefferson in a general course of north 70 degrees west for half a mile, where it flows into Lake Lafourche. The river has a strong tendency to leave its original bed through this outlet and cut a new channel into the lake. A sand-bar is forming in the Bœuf opposite the head of and extending below the outlet for 200 yards, in consequence of the loss of water through the outlet. This bar not only obstructs the bed of the river but turns the main body of water into the outlet, causing a very swift current during high stages of water, which is cutting away the south bank of the outlet, making it wider, and at each successive high water deepening its channel to the lake. If the water is allowed to continue to flow through the outlet the river will eventually leave its original course and flow into the lake, which has a good channel for

a distance of 8 miles, and then runs off into a low, flat swamp, where it spreads over several square miles of country without any defined channel; thence into Bayou Lafourche, which in turn flows into the Bœuf River 50 miles above its mouth. Outlets Nos. 2 and 3 do not flow out of Bœuf River, but out of Bonida Bayou, which empties into the Bœuf 3 miles above Point Jefferson. During high water, Outlets Nos. 2 and 3 not only discharge the water that comes down the Bonida, but Bœuf River backs up the Bonida and discharges a part of its waters through the outlets into Lake Lafourche. No. 2 flows into the lake 1 mile from where it leaves the Bonida, while No. 3 runs more to the west and flows into the lake 2 miles from the Bonida.

The benefit to navigation to be derived from the closure of Outlets Nos. 2 and 3 would be that the water that is now discharged into Lake Lafourche and carried into a swamp would be turned into Bœuf River, thereby rendering it navigable earlier and would, as the water fell, protect the navigable season, which at present is only about three months in the year. With these outlets closed, Bœuf River would be navigable as far as Point Jefferson at least four months, and possibly five months, in the year, say from February until June.

The benefit to be derived from closing the outlet at Point Jefferson is obvious; for if the river is allowed to continue to flow through the outlet into the lake, it will eventually leave its original bed, and flow through Lake Lafourche, which has no channel from its southern extremity to Bayou Lafourche, a distance of several miles, thus rendering it inaccessible to steamers from the lower Bœuf River.

The sand-bar in Bœuf River opposite the outlet is now 22.6 feet high, and is still forming, and will continue to form as long as the water is allowed to flow through the outlet, thus rendering the navigation below the outlet extremely difficult, except in high water.

My opinion is that if Outlet No. 1 is closed, the additional volume of water turned into the river by the closure of Outlets Nos. 2 and 3 will have a tendency to remove the bar, the flow will not be checked by loss of water through the outlet, and the deposit which is making the bar will cease. The outlet being closed the current will not be checked, but flow down across the bar, and while it may not remove the bar entirely, will, in my opinion, cut out a channel sufficient for navigation during ordinary stages of water.

The river at the lower side of the outlet has an average depth across of 7 feet, while at the lower point of the bar, 200 yards below the outlet, it has an average depth of only 2 feet; at the upper side of the outlet it has an average depth across of 17 feet, and for a distance of 200 yards above has an average depth of 10 feet. There are no sand-bars above the outlets, showing that the volume of water that comes to the outlets is sufficient to scour the channel and keep it clear of sand.

To close Outlet No. 1 it will be necessary to build an embankment 1,600 feet long. The main outlet is 255 feet wide, and will require to fill it 10,913.60 cubic yards, slope being 2 to 1, crown 10 feet, and for the remaining 1 345 feet will require 1,217.2 cubic yards, slope 1½ to 1, crown 4 feet; soil very stiff clay, underlying 2 feet of sandy loam, can be put in for 25 cents per cubic yard, making cost of closing Outlet No. 1, $3,032.68.

To close Outlets Nos. 2 and 3 it will be necessary to extend a line of levee from 500 feet back of the east bank of Outlet No. 2 to 450 feet beyond the north bank of Outlet No. 3, making a distance of 4,050 feet. To close the main channel of Outlet No. 2, a width of 235 feet, will require 9,230.60 cubic yards, slope 1½ to 1, crown 10 feet; the 500 feet on east bank will require 223.6 cubic yards; the line of levee connecting 2 and 3 will require 3,130.20 cubic yards, being an average fill of 4 feet. No. 3 will require 10,263.54 cubic yards, making total yardage for the 4,050 feet 22,847.9 cubic yards, and can be put in for 20 cents per cubic yard, making cost of closing Nos. 2 and 3, inclusive, $4,569.58, and total cost for the three outlets $7,602.26.

The soil of the surrounding country is a light sandy loam for a depth of 2 feet, underlying which is a stratum of stiff red clay 8 feet thick, under which lies clay of a dark-brown color, very stiff, heavy, and tenacious, which at the outlets extends below the water, forming a tolerably firm bottom. The country east of the outlets is all wild lands, subject to overflow about 5 feet deep.

The country north and west of the outlets for 2 miles is a succession of ridges, running a little south of west and parallel to each other, and is subject to overflow of about 3 feet, but gradually gets higher westward to Oak Ridge, which is above overflow, and continues to rise to the west for 5 miles to the foot of the Macon Hills. The planters here average 10 bales of cotton to each hand, making about 1,500 bales each on Oak Ridge, Prairie, Maronche, and Gum Ridge plantations annually. Many large plantations along the Bonida and Bayou Lafourche capable of a high state of cultivation are lying idle, owing to sickly climate and overflows caused by the outlets.

The commerce of Bœuf River at this point is about 10,000 bales of cotton, valued at $500,000, to which may be added almost an equal amount of return freight. No cattle are shipped from here, usually being driven out on foot. About 5,000 bales find their way to market by wagon to Girard, thence over the Vicksburg and Shreveport Rail-

way by way of Vicksburg to New Orleans. At present one steamboat, with a capacity of 1,100 bales, runs to Point Jefferson three months in the year.

By closing outlets of Bœuf River, the land above mentioned would be cultivatable and thereby greatly increase the commerce of the river.

Freight per bale by way of Girard is $2.50, while by way of the river it only amounts to $1.75 at low stages and $1.50 during high water.

Very respectfully, your obedient servant,

CHARLES QUINN,
Assistant Engineer.

Capt. ERIC BERGLAND,
Corps of Engineers, U. S. A.

U 26.

PRELIMINARY EXAMINATION OF BAYOU BARTHOLOMEW, FROM THE PRESENT HEAD OF NAVIGATION TO LINCOLN COUNTY LINE, ARKANSAS.

UNITED STATES ENGINEER OFFICE,
Vicksburg, Miss., January 15, 1885.

SIR: I have the honor to submit the following report upon the preliminary examination of Bayou Bartholomew, Arkansas, from present head of navigation to Lincoln County line, made in accordance with the requirements of the river and harbor act of July 5, 1884.

The present head of navigation is Baxter, Ark. At this point a pile-trestle railroad bridge forms a complete obstacle to navigation at all stages, and no Government funds have been expended for the improvement of the bayou above this point.

Above Baxter, to the Lincoln County line, the bayou is very crooked, as is shown by the accompanying sketch* of this portion of the stream.

The length of the bayou from Baxter to the Lincoln County line is about 80 miles, while the distance between these points, measured on a straight line, is not more than 23 miles.

The obstructions to navigation are the railroad bridge at Baxter and numerous snags, logs, and shoals in the channel, and leaning trees on the banks.

Assistant Engineer Charles Quinn was directed to make the examination, and his report is submitted herewith. The examination was made in December while the bayou was at its lowest stage, and when the obstructions to navigation could be plainly seen. These are fully described in Mr. Quinn's report, as are also the products of the country bordering the stream, and the benefits to navigation and commerce that may be expected from the improvement proposed.

It is estimated that the removal of the obstructions so as to insure navigation during ordinary stages, *i. e.*, about seven months in the year, would cost $20,000, or about $250 per mile.

I am of the opinion that this portion of the bayou is not worthy of improvement at present, or at least until the railroad bridge at Baxter is changed into a draw bridge, so that boats from below can pass that point. Were this obstruction removed, the funds hereafter appropriated for the improvement of the bayou could be applied above Baxter, after the improvement below Baxter has been completed.

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* Omitted; printed in House Ex. Doc. No. 147, Forty-eighth Congress, second session.

From Baxter to the mouth the distance is about 296 miles, on which portion work has been done over a distance of 238 miles, and nearly $18,000 expended.

No further survey is considered necessary.

Very respectfully, your obedient servant,

ERIC BERGLAND,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

REPORT OF MR. CHARLES QUINN, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Vicksburg, Miss., December 26, 1884.

CAPTAIN: I have the honor to submit the following report upon an examination of Bayou Bartholomew, Arkansas, made under your direction, with a view to its improvement.

In obedience to your letter of instructions of 3d instant, I proceeded to Arkansas City by steamer, thence to Baxter, Ark., on Bayou Bartholomew, by rail. I found it would be impossible to make the examination in a skiff or boat of any kind, owing to the low stage of water and the number of logs, trees, &c., which filled the bed of the stream, and I procured a horse at Baxter, on which to pack camp utensils, provisions, &c., and with one laborer proceeded to the Lincoln County line (southern boundary), where I began the examination on foot. The water in the bayou being at its lowest stage afforded every facility for making a thorough examination, as all the obstructions that would be at all likely to interfere with navigation were exposed.

Bayou Bartholomew, from Lincoln County line to Baxter, a distance of 80 miles, is in a very unsafe condition, either during high or low water, on account of the various obstructions which fill the bed and line the banks of the stream. For convenience I will divide it into two sections, taking the upper reach first, *i. e.*, from Lincoln County line to the mouth of Able's Creek, which embraces the worst part of the stream. In this reach, for 2 miles from the Lincoln County line, the bayou has a width of from 50 to 75 feet, with a depth of 2 to 3 feet, and with only a few obstructions, but after reaching the Taylor Place the stream is obstructed with a sand-bar and drift-piles. The bar is caused by a slough or drain which empties into the bayou, and trees growing on the bar catch the drift which has closed the channel entirely for navigation.

From Taylor's to the Lynch Place the bayou makes a very long bend, and is not so wide, varying from 30 to 60 feet, and has a depth of only 12 inches at the two narrowest places, *i. e.*, at the Stanley Place, and one below, near Crowell's.

The banks have the same general features, sloping gently for 100 feet on either side to a height of about 15 feet, and then rising rapidly from 5 to 10 feet.

From Lynch's to the mouth of Able's Creek the stream gradually grows wider, though the bends become more tortuous, and in many places it would be impossible for the smallest steamboat to pass them. There are also many leaning trees around these bends, which, during high water, catch the floating drift and form drift-piles, and in many places trees have been felled across the bayou which also catch drift and form other drift-racks.

From the mouth of Able's Creek to Baxter the general features of the bayou change somewhat, the channel getting wider and deeper, varying from 75 to 125 feet in width, with a depth of from 5 to 6 feet, except at the three fords, viz, one at Taylor's Place, one above the Hunter Place, and one at the White Place, where there is an average depth of 2 feet.

The banks are heavily timbered, but do not interfere with navigation except in the short bends where the trees almost lap across the stream. The best stave timber in the State grows along this reach, vast quantities of which are made into staves annually by enterprising men who recognize the superior quality of the timber in this section. Oak, ash, elm, sweet gum, sassafras, pecan, hickory, and some cypress grow along the stream, and from 1 to 2 miles back on both sides of the bayou there are many large cypress brakes filled with the very finest timber for lumber, shingles, laths, &c., and if a convenient means of transportation was furnished by way of the bayou all this valuable timber would doubtless be sawed into lumber and thus be brought to market. There is but one saw-mill on the bayou, situated at Baxter, which saws about 200,000 feet annually, most of which is used in the surrounding country, none being shipped.

The Little Rock, Mississippi River and Texas Railroad, east of the bayou, runs almost parallel with the stream, and at Winchester is only 5 miles from it, and varies

from to 5 to 18 miles at different points. This road furnishes the only means of transportation for the produce raised along the upper bayou, and the Monticello, or southern branch, furnishes transportation for those living on the lower bayou, in the vicinity of Baxter, Collins, and Dermott, but, owing to the bad condition of the roads in this section during the rainy season, it is with the greatest difficulty that the farmers get their produce to market, or to the stations along the railroad, which are Winchester, McGehee, and Tillar, on the Little Rock branch, and Baxter, Collins, and Dermott on the Monticello branch.

A great many farmers living on the west side of the bayou haul their entire crops to Monticello, a distance of 25 miles, preferring to do so on account of having better roads.

This section of country, along the bayou for a distance of 1 mile on each side, produces annually about 2,000 bales of cotton, 1,000 tons of cotton-seed, and some cattle and hogs. The country lying parallel to the bayou, for a distance of 6 miles back on both sides, produces about 10,500 bales of cotton, 5,000 tons of cotton-seed (this including the first-mentioned strip lying along the bayou), part of which finds its way to market by way of the Little Rock, Mississippi River and Texas Railroad, as follows:

Station.	Distance from bayou.	Staves.	Cotton-seed.	Cotton.
	Miles.	*Number.*	*Tons.*	*Bales.*
Winchester	5	.....	100	2,000
Tillar	5	15,000	200	2,000
McGehee	6	10,000	100	1,000
Collins	4	.....	100	1,000
Baxter	.....	.....	200	2,000
Dermott	.....	.....	100	2,000
Total	.....	25,000	800	10,000

About 500 bales of cotton are shipped by way of Monticello.

The bayou, never having been considered a navigable stream, has no shipping points on it, except for staves, about 200,000 of which are shipped annually on flat-boats down the bayou, and 25,000 by way of Tillar and McGehee.

The following table gives widths and distances at different points on Bayou Bartholomew, the Lincoln County line being the initial point:

Places.	Distance.	Width.		Ferries.	Fords.
		Top.	Bottom.		
	Miles.	*Feet.*	*Feet.*		
Lincoln County line	0	.....	.....	.....	.....
Dr. Taylor's	2	125	50	1	1
Lynch's	15	300	60	1	.....
Bob Taylor's	25	200	75	1	.....
Simmons's	33	225	100	.....	.....
Pruett's	37	400	125	1	.....
Jones's	40	250	100	1	.....
Above Hunter's	44	200	80	.....	1
Kayson's	51	175	75	.....	.....
Mrs. Duncan's	56	200	100	1	.....
White's	70	400	75	.....	1
Collins's	79	250	100	.....	.....
Baxter	80	300	80	1	.....

The bridge of the Little Rock, Mississippi River and Texas Railroad, which crosses the bayou at Baxter, is an effectual bar to navigation above that point. The bridge-crossing is a pile-trestle, 350 feet long with bents 12½ feet between centers, except the channel span, which is 25 feet between centers; the height of rail being about 24 feet above the bed of the stream. As the high water of 1882 and 1883 touched the stringers, it will be seen that the bridge is a bar to all navigation, and if the improvement of the upper bayou is carried into execution, I would suggest that a draw-span be put in, *i. e.*, a pivot draw 125 feet long, the pivot pier to be of masonry and end piers of hollow iron cylinders filled with concrete.

OSCILLATION, BED OF STREAM, ETC.

I found water-marks all along the bayou, and from these I judge the oscillation is about 20 feet.

The bed of the bayou, throughout the entire reach from Lincoln County line to Baxter, has the same general character; it is of a soft loam or alluvial deposit, there being no sand except where it is washed into the bayou by drains from the fields.

The banks as a general thing slope gradually from the water's edge, but in some places form natural terraces, and at others, as at the Stanley Place on the east bank, rise very abruptly.

The banks average in height from 25 to 30 feet and never overflow, and the only way in which the bayou is affected by high water from the Mississippi is by back-water from the lower bayou.

BENEFIT TO BE DERIVED.

The lands lying along the bayou are of the finest, but, owing to the difficulty of getting produce to market, many places are lying idle and others only half cultivated, which probably would not be the case if there was a convenient mode of transportation, and not only the cotton raised immediately on the bayou, but at least one-third of that which is now shipped at the stations before mentioned, would find a way to market by the bayou if it was made navigable, and at least 2,000 tons of cotton-seed, of which only a few hundred tons now find a way to market, on account of bulk and inconvenience in handling, thus adding another source of wealth to this section. The seed alone would amount to about $16,000, and cotton, which at present costs $2 per bale transportation to New Orleans, could be taken out by the bayou for $1.75 per bale, and an equal amount saved in return freights.

There would also be an increase in the manufacture of staves, of which about 225,000 are made on the bayou annually, and the fine cypress timber on both sides of the bayou would be converted into lumber and be carried to market, if the bayou was made navigable, thus rendering another source of revenue to this section.

Unless navigation is opened this timber is entirely worthless, as there is no cheap means of transportation such as the bayou would afford.

OBSTRUCTIONS TO NAVIGATION.

The obstructions along this reach. from Lincoln County line to Baxter, consist of snags, logs, imbedded logs, leaning trees, &c. Some of these obstructions have been cut in order to allow stave boats to pass at ordinary stages of water, but at low water it is impossible for boats of any kind to ascend or descend the stream.

IMPROVEMENTS AND ESTIMATES.

The proposed plan of improvement, for the present, is to cut down the leaning trees and remove the logs, snags, and timber at points where the bends are so abrupt as to require it, in order to give room for boats to pass.

The working season would be from August to January, during which time the water would be low enough to allow the work to be done economically.

The outfit would consist of a flat-boat, with the necessary machinery, tools, &c., for removing the obstructions.

An extra party could also be employed on the banks cutting the leaning timber. The timber will have to be disposed of on the bank, for if cut into short lengths and left in the stream the current would not be sufficient to take them out, and as the banks never overflow, they would be kept in the channel and form into drift-racks.

ESTIMATES.

1 flat-boat	$1,200
1 engine	900
Tools, rigging, &c	600
Repairs and incidentals	300
Total	3,000
Labor:	
1 assistant engineer, per month	150
1 foreman, per month	100
1 engineer, per month	90

1 cook, per month	$50
20 laborers, at $40 per month each	800
Subsistence for 24 men, at 50 cents per day	360
Total for one month	1,550
Total for ten months (two seasons)	15,500
Cost of outfit	3,000
Contingencies, 10 per cent	1,850
Total cost for improvement	20,350

It may be possible to procure labor for less than the amount in the estimates, but the work must be conducted at a season when labor is needed for picking cotton, for which good wages are paid, and labor will probably have to be procured from the Mississippi River, where roustabouts and other laborers on steamboats receive from $80 to $100 per month.

The flat boat will have to be built above the railroad bridge which crosses the bayou at Baxter, and should not have more than 15 inches draught.

Very respectfully, your obedient servant,

CHAS. QUINN,
Assistant Engineer.

Capt. ERIC BERGLAND,
Corps of Engineers, U. S. A.

U 27.

EXAMINATION OF CYPRESS BAYOU AND THE LAKES BETWEEN JEFFERSON, TEXAS, AND SHREVEPORT, LOUISIANA.

UNITED STATES ENGINEER OFFICE,
Vicksburg, Miss., January 5, 1885.

SIR: In compliance with letter to Maj. A. M. Miller, Corps of Engineers, dated Office of the Chief of Engineers, U. S. Army, Washington, D. C., July 31, 1884, and the requirements of the river and harbor act of July 5, 1884, I have the honor to submit the following report on the examination of Cypress Bayou and the lakes between Jefferson, Tex., and Shreveport, La., made for the purpose of ascertaining "if the necessary improvement cannot be made upon some other plan than building a dam across the Albany Flats, as recommended by the engineer."

A report upon the examination of Cypress Bayou was sent to the Department by Major Miller, with letter dated August 1, 1883. In this report the amount estimated for the necessary improvement was given at $19,000.

In order to ascertain whether any important changes had occurred since the examination in 1883, I directed Assistant Engineer F. S. Burrowes to make an examination and submit plan and estimates for improvement. His report, which is submitted herewith, describes in detail the existing obstructions to navigation, the estimated cost of removing these, and the benefits to commerce that may be expected from such improvement.

It is estimated that an expenditure of $16,000 will secure safe navigation between Jefferson, Tex., and Shreveport, La., for a period of seven or eight months each year.

As $94,000 has heretofore been appropriated for this improvement, I would recommend that the amount required to complete it be appropriated.

No work has been done on Cypress Bayou since 1880, with the exception of the removal of a number of leaning trees in February, 1884.

A map* of Cypress Bayou and the lakes between Shreveport, La., and Jefferson, Tex., is submitted herewith.

Very respectfully, your obedient servant,

ERIC BERGLAND,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

REPORT OF MR. F. S. BURROWES, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Vicksburg, Miss., December 26, 1884.

CAPTAIN: I have the honor to submit the following report upon an examination of Cypress Bayou, Texas and Louisiana, made under your direction, with a view to its improvement by some other method than the construction of a dam and cut across Albany Flats, near the foot of Sodo Lake.

Procuring a skiff, tent, sounding-rod, &c., from the Government store-boat at Shreveport, I employed two skiffmen, and proceeded thence over the steamboat route to Jefferson, Tex., taking soundings and noting the character of the bed and banks and obstructions.

On account of the small amount of funds available it was not possible to make an instrumental survey, and therefore the map from the survey of 1872, by Lieutenant Woodruff, Corps of Engineers, was used for distances and other data not accurately obtainable during a hasty examination.

CYPRESS BAYOU ROUTE.

The improvement of Cypress Bayou has always heretofore included the entire navigation from Shreveport, La., to Jefferson, Tex., a distance of 65 miles, and embraces much more than Cypress Bayou proper.

The route, starting from Shreveport, is through Twelve Mile Bayou, across Sodo Lake, and thence, through Little and Willow Passes, to Fairy Lake. It then meanders through the entire length of Fairy Lake, enters the mouth of Cypress Bayou, and follows the course of that stream to Jefferson.

The true mouth of Twelve Mile Bayou is 3½ miles above Shreveport, but owing to a cut-off in Red River, 1 mile above Shreveport, and the consequent partial closure of the upper arm of the bend, the mouth of the bayou is now generally assumed to be at the foot of the cut-off.

Throughout Twelve Mile Bayou, which has a length of between 11 and 12 miles, there is never less than 4 feet of water at the lowest stage. It has a width varying from 200 to 400 feet, and a current so swift that great difficulty was found in ascending it with a skiff.

From the head of Twelve Mile Bayou to Albany Flats the channel through Sodo Lake contains all the water during a low stage, and is merely a continuation of Twelve Mile Bayou, being 200 feet wide, from 4 to 6 feet deep, and having a strong current.

Albany Flats is a low mud-bar, across which boats pass at a medium stage of water, a distance of 1 mile. The low-water channel, however, makes a detour around the flats 2 miles in length; has a very swift current, and a depth of only from 1½ to 2 feet. Just above Albany Flats, where the low-water and high-water channels come together, is what is known as the "Gate Posts." At this point the water spreads out and the current becomes almost imperceptible, thus forming the true beginning of Sodo Lake at low water. The route across this lake is comparatively straight, and has a length of 5 miles. There was, however, only from 2 to 3 feet of water throughout the entire distance, and the channel was much obstructed with stumps, the tops of which came just to the surface of the water. From the best information I could obtain I judged the water to be from 6 inches to 1 foot above its lowest stage.

Little Pass, which joins Sodo Lake and Willow Pass, is 200 feet wide, one-half a mile long, and from 5 to 8 feet deep. It contains a few large stumps, which would prove serious obstacles to low-water navigation.

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*Omitted; printed in House Ex. Doc. No. 103, Forty-eighth Congress, second session.

Willow Pass has a length of 2 miles, is from 5 to 15 feet deep and 300 feet wide. It is almost entirely free from obstructions.

The low-water steamboat channel through Fairy Lake is very crooked; has a total length of 16 miles, and a general depth of from 8 to 10 feet. At one time this lake was covered with a growth of heavy cypress timber, the stumps and trunks of much of which still remain. The original channel was cleared out by steamboat men, who cut some of the worst trees and stumps to about the level of low water, and avoided others by making the channel very crooked in many places. This channel has since been improved at various times, both by the city of Jefferson and the United States Government, but in very few cases have the obstructions been removed below low-water mark, thus necessitating a rise equal to the draught of the boats used to yield safe navigation.

From Fairy Lake the channel enters Cypress Bayou, a stream which has a natural width of from 200 to 300 feet, and a length to Jefferson of 24 miles. It has a least depth of 7 feet, except at a point a half a mile below Jefferson, where there is a shoal only 3 feet deep, and through the artificial cut-offs. These cuts were originally from 6 to 7 feet deep below low water, but they have gradually refilled from the effects of surface wash and cross currents until in a number of places there is only from 3 to 4 feet of water, and in one small cut only 1½ feet of water.

STAGE OF WATER, OSCILLATION, ETC.

The stage of water at Shreveport, at the time of the examination, was 6 feet above low-water mark, and yet, as stated above, it was found to be less than 1 foot above low water at Albany Flats and through Sodo Lake. On a 6 to 8 feet stage of water, at Shreveport, through boats to New Orleans begin to run from that point, while the very lightest-draught boats are unable at the same stage to make the trip to Jefferson with any degree of safety. It is claimed that in former years navigation to Jefferson opened almost simultaneously with that to Shreveport. The reason most generally assigned for the present shortening of the navigable season is the removal of the raft from Red River above Shreveport, and the closure of some of the outlets of that stream. That these circumstances have had a limited adverse effect upon the navigation of the lakes is no doubt true, for the following reason: The slope of Upper Red River is much greater than through Twelve-mile Bayou and the lakes, thus making points on the river higher than opposite points on the lakes; and so long as the bed of the river was filled with a jam of logs the water was forced through the openings and over the banks into the lakes, which caused and maintained an increased elevation of their water-surface, whenever there was any considerable rise in Upper Red River. As nearly all of the large outlets still remain open, most of the water supply of the lakes is still derived from Red River; but as the concentration of the water has doubtless caused a gradual deepening of Red River, and a consequent lowering of its water-surface, the height of the water in the lakes has perhaps likewise been decreased without the compensating advantage of scouring action.

The extreme oscillation of the water-surface in Cypress Bayou at Jefferson is 23 feet, and in Fairy Lake between 6 and 7 feet.

DAM AT ALBANY FLATS.

In order to reclaim and improve navigation through the lakes, Major Howell submitted in 1874 a project for the construction of a high-water dam and a cut from Albany Point, on Sodo Lake, to Gold Point on Red River, thus making the outlet from the lakes into Red River, instead of through Twelve-mile Bayou, as at present. As the surface of the water in Red River at Gold Point is 6 feet higher than the surface of the water in Sodo Lake at Albany Point, the object was to gain the advantage of this extra elevation across the shoal water of Sodo Lake. This plan would undoubtedly solve the problem of navigation through the lakes, but its great cost (estimated at $372,580) has proved thus far an insurmountable obstacle to its adoption.

PREVIOUS IMPROVEMENT.

When the city of Jefferson found that her trade was, from various causes, rapidly decreasing, an effort was made to improve Cypress Bayou, so as to make navigation less hazardous. For this purpose a dredge-boat was built, with which one cut-off was made, and a number of the worst stumps and trees removed. Subsequently the United States Government made appropriations of various amounts, from 1872 to 1879, inclusive, aggregating $94,000 to continue the improvement.

With this amount the dredge-boat was purchased from the city of Jefferson and a number of cut-offs made, as follows: Bois d'Arc Pass, being at the entrance of the bayou from Fairy Lake, two small cuts at Benton, known as Upper and Lower Ben-

ton; two small cuts at Sisco Island, and one short and one long cut at Dougherty's Defeat Bend, known as Middle and Little Cypress cuts, respectively. These were all originally 48 feet wide and from 6 to 8 feet deep. Their present condition is as follows: Bois d'Arc Pass Cut is 5 feet deep at low water and in good condition, but, as it was never completed so as to connect with the deep water in the lake, an extension of 1,000 feet should be made to its lower end. The Benton Cuts are in good condition and need no further work done on them. The Sisco Island Cuts are from 3 to 4 feet deep; the Middle Cypress has an available depth of only 1½ feet, and the Little Cypress has shoaled to a depth of 3½ feet.

A considerable amount of work was also done in the way of removing stumps and snags from the bayou, and in cutting stumps down to low-water level through the lakes.

OBSTRUCTIONS.

The principal obstacle to navigation is the small depth of water around Albany Flats and through Sodo Lake. The depth of water over this portion, besides being very small, is rendered entirely unavailable for low-water navigation by numerous stumps in the channel, reaching to and above low-water mark. The channel through Fairy Lake is also obstructed by stumps and trees, and is so crooked and ill-defined as to be difficult to follow during daylight, and impossible to navigate with safety at night.

The course of Cypress Bayou proper is almost entirely free from obstructions, except from the shoaling of the water through the artificial cut-offs.

NAVIGATION.

At one time the number of boats running to Jefferson was very large, through boats plying between that point and New Orleans, Saint Louis, and Cincinnati. They have decreased in size and number until during the past season the only craft in the trade was a small stern-wheel steamboat, drawing about 2½ feet of water, which made irregular trips from Shreveport to Jefferson.

COMMERCE.

Jefferson, being the head of navigation, has heretofore been the only shipping point of consequence on Cypress Bayou, and the trade of that city represented almost the entire commerce of the stream. At one time it was a city of from 10,000 to 15,000 inhabitants, shipped by boat annually 75,000 bales of cotton, and was the shipping and supply point for a large area of the northeastern part of Texas. The construction of railroads, which furnish other and more convenient means of outlet, assisted to a very limited extent by the partial deterioration of the navigable condition of the bayou, has had an almost disastrous effect on the town. It has now less than 5,000 inhabitants and is the shipping point for only 10,000 to 15,000 bales of cotton annually, with a proportionate loss in its supply business. There is a large cotton compress there, which compresses annually about 60,000 bales. This is, however, handled by the railroads, being merely stopped in transit to be compressed, and would not under any circumstances be tributary to the commerce of the bayou. There was less than 500 bales of cotton shipped from Jefferson last year by boat, and 600 tons of freight received, while on the bayou below Jefferson there were 1,500 bales of cotton shipped and 1,600 tons of freight received.

PLAN OF IMPROVEMENT.

Any scheme for the improvement of the bayou, having in view the maintenance of navigation throughout the year, would necessarily be open to the same objection as the cut and dam across Albany Flats, that is, a cost entirely disproportionate to the benefits accruing therefrom.

The only improvement which will be estimated for is the removal of all stumps from the shoal water at Albany Flats and through Sodo Lake, so as to make the entire depth of water available for navigation, the straightening of the channel through Fairy Lake, and the cutting of the stumps to a depth corresponding to that obtained through Sodo Lake, continuing Bois d'Arc Pass Cut to deep water in the lake, and reopening the Sisco Island and the Cypress Cuts, and also for boards painted so as to indicate the side of the channel, to be placed either on trees or on posts planted for the purpose. Such improvement would give good and safe navigation to Jefferson for seven or eight months in the year.

For reopening the cuts, the dredge-boat Lone Star could be repaired and used. It would be advisable, however, instead of placing the material on the banks directly

from the dipper, as was done heretofore, to use scows for receiving the material and transferring it to deep water, as experience has shown that material placed close to the edge of the cut soon washes back and tends to refill it.

Dynamite cartridges could be used to advantage in removing the stumps in the shoal water, as well as for lowering the tops of those in deeper water.

COST OF IMPROVEMENT.

The following estimate is held to include all cost of dredging, removing stumps, and marking channel, according to the plans given:

ESTIMATE.

Repairs to dredge-boat	$3,000
Six months' work for dredge-boat	5,700
Building two scows	500
Removing stumps:	
Flat-boat and outfit	1,000
Expense of working party for four months	3,200
1,000 pounds dynamite	750
Marking channel	300
Engineering and contingencies, 10 per cent. added	1,445
Total	15,895

ADVISABILITY OF IMPROVEMENT.

Although the commerce of the bayou during the past ten or fifteen years has decreased from a large and paying traffic to almost nothing, this state of affairs is not chargeable wholly, nor even to any considerable extent, to the fact that the navigation of the bayou has become more difficult and dangerous. As stated before, the building of railroads has furnished more convenient outlets for a large section of country which had been tributary to Jefferson, and thus caused its decline as an important commercial center.

While the carrying out of any expensive scheme of improvement could hardly be regarded as advisable, yet the expenditure of the amount estimated would, by giving safe navigation for a portion of the year, afford great relief to the inhabitants from exorbitant rates on freight by rail.

Up freight by boat from New Orleans to Jefferson has been as low as 16 to 20 cents per hundred, and it costs $1.25 per bale to ship cotton by water from Jefferson to New Orleans. The railroads are, of course, compelled to meet these rates, but when navigation is closed, or where there is no boat in the trade, they charge from 60 to 80 cents per hundred on up freight, and $2.50 per bale for cotton.

Very respectfully, your obedient servant,

F. S. BURROWES,
Assistant Engineer.

Capt. ERIC BERGLAND,
Corps of Engineers, U. S. A.

APPENDIX V.

IMPROVEMENT OF ARKANSAS RIVER; OF RIVERS IN THE STATE OF ARKANSAS, AND THE BLACK RIVER IN ARKANSAS AND MISSOURI.

REPORT OF CAPTAIN H. S. TABER, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1885, *WITH OTHER DOCUMENTS RELATING TO THE WORKS.*

IMPROVEMENTS.

1. Removing obstructions in Arkansas River, Arkansas.
2. Arkansas River between Fort Smith and Wichita, Kansas.
3. Arkansas River at Fort Smith, Arkansas.
4. Arkansas River at Pine Bluff, Arkansas.
5. Black River, Arkansas and Missouri.
6. White River, Arkansas.
7. White River above Buffalo Shoals, Arkansas.
8. White River between Jacksonport and Buffalo Shoals.
9. White and Saint Francis rivers, Arkansas.
10. Saint Francis River, Arkansas.
11. Saline River, Arkansas.
12. L'Anguille River, Arkansas.

EXAMINATIONS AND SURVEYS.

13. Survey of Arkansas River from Little Rock to its mouth.
14. Continuation of survey of Arkansas River from Wichita, Kansas, to Fort Gibson, Indian Territory.
15. Little Red River, Arkansas.
16. Red River above Fulton, Arkansas.
17. Petit Jean River, Arkansas.

UNITED STATES ENGINEER OFFICE,
Little Rock, Ark., July 1, 1885.

GENERAL: I have the honor to transmit herewith the annual reports for the fiscal year ending June 30, 1885, upon the works under my charge.

I am, general, very respectfully, your obedient servant,

H. S. TABER,
Captain of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

V 1.

REMOVING OBSTRUCTIONS IN ARKANSAS RIVER, ARKANSAS.

As the first expenditure of money on this river was made as early as 1833, it is not an easy matter to determine what was the original condition of the navigable portion of this stream; but from the delta-like character of its lower portion and the tendencies now manifest in its upper reaches, it may be inferred on very substantial grounds that shifting sand-bars, numerous drift-piles, and dangerous snags characterized the obstacles to navigation in the lower reaches, and gravel and rock shoals, with a few snags and many overhanging trees, constituted those of the upper reaches. The numerous so-called steamboat graveyards now pointed out by old pilots support this idea. Such Annual Reports of the Chief of Engineers as I have, dating from 1873, together with House Ex. Doc. No. 64, Forty-eighth Congress, first session, indicate that, except at a few places, such as Pine Bluff, Ark., and Fort Smith, the general plan of improvement has consisted in snagging operations, which includes cutting overhanging trees and in building wing-dams to improve the shoals, the idea being to afford temporary relief to navigation until complete surveys should render it possible to project a plan for the radical and permanent improvement of the navigable portion of the entire river. For the exceptions noted attention is respectfully invited to reports upon those special cases. The appropriations have been made sometimes for the entire navigable reach and sometimes for certain sections. The grand total of all these appropriations up to June 30, 1885, amounts to $420,376.87. Of this there had been expended to June 30, 1884, $311,511.56, exclusive of certain sums, aggregating over $100,000, that were appropriated with the Mississippi and Missouri rivers, so as not readily to be determined. The most permanent result of all this expenditure consists in a series of maps made by S. T. Abert from a survey of the river from Fort Gibson, Indian Territory, to Big Rock, Ark., 3 miles above Little Rock, Ark., in the year 1870. From the nature of the case of the balance of the work has been each year a repetition of that of preceding years. One iron-hulled snag-boat and one light-draught wooden snag-boat, with all the appliances necessary for snagging operations, were the visible signs of the balance, while the gratitude of those interested in the navigation of the river for a navigation rendered yearly less and less dangerous by the operations of these two boats is the only evidence existing, and the only evidence to be expected, of work that must be done in a stream like this until by some system of permanent improvement caving banks no longer exist and the annual quota of snags is no longer furnished. Steamboat graveyards have been rendered a matter of tradition, and yet July 1, 1884, found the entire reach of river from Fort Gibson to its mouth so full of snags that the two snag-boats were kept fully employed until the high water of the winter and spring of 1884–'85 stopped their operations.

During the fiscal year ending June 30, 1885, $28,702.79 was expended in the running expenses of these two boats and in their care, as their operations seemed to give, for this season, the greatest relief possible, and the relief most needed. Too much cannot be said in favor of the wisdom of making the last appropriation apply to the entire river, and leaving it to the officer in charge to expend it as seemed most advisable. By this means a narrow channel was opened from the mouth of the river to Fort Gibson and navigation resumed at once, and this was

afterwards widened as required, until at length a heavy line of packets was put on from Little Rock to the mouth, and the line that formerly plied on this reach was transferred to the reach above Little Rock. In February, 1885, the boats actually made their regular time by night, and on one occasion I traveled upon the heaviest snag-boat from dark until nearly midnight, the pilot having no difficulty whatever, and this at a medium stage of water, too. When it became evident that no regular appropriation would be passed at or near the beginning of the fiscal year ending June 30, 1886, the boats were at once withdrawn from work, and a small sum ($8,320.33) was reserved for their care and for the running expenses of one of them when the river should be in its worst condition. During the year just specified two heavy rises have again filled the river with snags, though with not so many as usual, owing to the trees cut upon caving banks the past season. Yet at this writing, July 1, 1885, it would be impossible to take any one over the river and make them believe that in February, 1885, it was carrying safely so much traffic. Thirty-six thousand dollars is needed for the fiscal year ending June 30, 1886, and inasmuch as it has not been appropriated, $50,000 will be too small a figure to meet the requirements of the fiscal year ending June 30, 1887, if no appropriation is made for that ending June 30, 1886. Should the appropriation for that year be made, as recommended, then $30,000 to $35,000 will answer for year ending June 30, 1886. By September 1, 1885,* the surveys preparatory to the permanent improvement of the entire river will have been so far advanced (see special reports upon each) that it will be possible to prepare plans and estimates for this improvement. The charts of Mr. S. T. Abert's survey lie in the office in charts 10 by 4 feet. It will take about $1,000 to reduce and trace them preparatory to forwarding to Washington.

The following is a tabulated statement of the work done by each snag-boat:

Work done.	Name of boat.	
	C. B. Reese.	Wichita.
Miles run	2,006½	1,870
Snags pulled	1,197	388
Trees cut	7,404	6,189
Trees deadened		17
Drift-piles removed	17	2

Great stress has been laid upon keeping each boat at its work. Again, the boats were worked so as to practically relieve the navigation. Plainly, it is of little use to thoroughly clear out one reach and leave all the others choked; but by opening a passable channel at once, and then widening it gradually, good service is rendered and the river made available longer.

Total appropriations to June 30, 1885	$420,376 87
Total expended to June 30, 1884	311,511 56
Amount available, July 1, 1884:	
Pine Bluff	712 86
Arkansas River, Arkansas and Kansa	7,875 95
Mississippi, Missouri, and Arkansas rivers, applied to Arkansas River	1,021 94
Survey	2,754 56

*Just prior to the time of sending in these reports time was gained to submit certain plans and estimates, for which please see report on the survey of the Arkansas River, Arkansas.

Appropriated, act approved July 5, 1884:	
Pine Bluff	$55,500 00
Fort Smith	5,000 00
This head	36,000 00
Survey	19,000 00
Total available in fiscal year ending June 30, 1885	108,865 31
Expended to June 30, 1885:	
Arkansas River, Arkansas and Kansas	7,875 95
Mississippi, Missouri, and Arkansas rivers, applied to Arkansas River	1,021 44
Pine Bluff	49,139 73
Fort Smith	5,000 00
Survey	19,644 72
This head	28,702 79
Amount available July 1, 1885:	
Pine Bluff	7,073 13
Fort Smith	0,000 00
This head	7,297 21
Survey	2,109 84
Amount that can be profitably expended during the fiscal year ending June 30, 1887	50,000 00

If an appropriation is made of $30,000 or more during the year ending June 30, 1886, then this $50,000 should be made $35,000.

Money statement.

Amount appropriated by act approved July 5, 1884		$36,000 00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$28,368 79	
July 1, 1885, outstanding liabilities	334 00	
		28,702 79
July 1, 1885, amount available		7,297 21
Amount that can be profitably expended in fiscal year ending June 30, 1887 Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		50,000 00

EXPENSE ACCOUNT REMOVING OBSTRUCTIONS IN ARKANSAS RIVER, ARKANSAS, FOR THE YEAR ENDING JUNE 30, 1885.

Pay-rolls, labor	$18,568 38
Subsistence supplies	4,216 58
Traveling expenses	192 13
Stationery	98 90
Fuel	2,150 54
General supplies	1,983 98
Telegraph services	3 72
Machinery	1,038 85
Lumber	39 71
Office rent	60 00
Skiff	25 00
Total	28,377 79

COMMERCIAL SLATISTICS.

Letters were sent, several weeks prior to the 1st of July, to parties interested in the river for statements of the commerce, but no answers have been received, so that the statistics as given in former years are again submitted.

I learn, however, that this commerce would be represented by from 80,000 to 100,000 bales of cotton above Little Rock. The facts in regard to the lower river commerce cannot be better set forth than by quoting the following letter:

"LITTLE ROCK, ARK., *June* 11, 1885.

"DEAR SIR: I have the honor to acknowledge the receipt of your communication of the 31st ultimo, asking me for some statistics relative to the trade upon the Arkan-

sas River in its connection with the benefits accruing from the work of the United States snag-boats, and in reply I will say that the advantages derived from the use of the United States snag-boats upon this river during the past year are beyond computation. I have been interested in boats on this river for many years, and there has been no year up to the last one when there has not been one or more boats sunk by snags on this river; but there has not been an accident of this kind for the last twelve months. I attribute this immunity from such casualties wholly to the United States snag-boats. As this river becomes full of drift-wood, every rise, snags are planted again, and when the water goes down, after a heavy rise, these snags are found in the channel where none existed before. Therefore the work of removing them is endless upon this river.

"Taking into consideration the amount of cotton and other merchandise brought up this river, all on steamboats, the expense to the Government to maintain these snag-boats is merely nominal. Steamboats carry out of this river annually about 70,000 bales of cotton, and also transport thousands of tons of cotton-seed both ways to Memphis on the Mississippi River, and to Little Rock from various places along the entire length of the river.

"Averaging this cotton at $50 per bale aggregates $3,500,000; adding to this the value of the cotton-seed, say $600,000, and the merchandise brought up the river, say $1,500,000, there results a total trade amounting to $5,500,000. This estimate is only a part of the river below Little Rock, no calculation being made for the trade above here, with which I am not very familiar, not having been interested in it for many years until the last month or so. But I have been interested in and perfectly familiar with the trade between this point and the mouth of the river the last thirty-two years. I sincerely hope that the present Congress will make such an appropriation for this work as will keep the snag-boats constantly occupied in operations upon the Arkansas River, for they have long since ceased to be an experiment, and have become a necessity.

"I am, sir, very respectfully, your obedient servant,

"JNO. D. ADAMS,

"*President Memphis, Vicksburg, and Arkansas City Packet Company.*"

V 2.

IMPROVEMENT OF ARKANSAS RIVER BETWEEN FORT SMITH AND WICHITA, KANSAS.

This part of the Arkansas River originally offered many obstructions to navigation in the way of shoals, snags, and overhanging trees, rendering navigation very dangerous, and at certain stages of water practically impossible. The original plan of improvement had for its object the removal of the snags and overhanging trees, and the contraction of the channel at the shoals. Since the original plan was adopted several surveys have been made with a view to the permanent improvement of this reach.

Up to June 30, 1885, there has been expended under this head of appropriation $59,000, to say nothing of certain amounts that were applied as early as 1833 to the river in general. This expenditure has been of such practical value to navigation that, while in former years there were regular steamboat graveyards, with numerous occupants, at present the sinking of a steamboat is practically an unheard-of occurrence, and the river, with the exception of several unimproved shoals, is in excellent navigable condition as high as Fort Gibson, Indian Territory. Above this point it will require a large outlay to make the river navigable, as will be seen by referring to the report upon the survey of the river from Wichita, Kans., to Fort Gibson. There was $7,875.95 available on this appropriation July 1, 1884, which amount was turned over to me by my predecessor, Major Adams. This amount was expended in the running expenses of United States snag-boat Wichita, and in the survey of Canadian, Webber's Falls, Taylor's Bar, Hildebrand's Bar, Bouidenott,

and Rabbit's Ford Shoals, with a view to giving an estimate for their improvement.

The *Wichita* worked July, August, September, and November, under this head, and removed during that time 659 snags, cut 732 overhanging trees, and removed one drift-pile, and left the river from Fort Gibson down in the best shape it has been in for years. She was first required to open a channel through, then to widen this channel, and finally to remove such trees on caving banks as are likely to become snags, experience showing that when the stump is severed from the trunk, the trunk alone seldom becomes a snag, and the stump sinks out of sight.

Before the heavy spring rises came on, the river as to snags for this reach was in splendid shape, and boats were making regular trips, running night as well as day. Attention is invited to the record of the boat, working, as it has, systematically back and forth, as over against her record in past years, working to finish up one place before rendering aid elsewhere. Her expenses have been:

Items:	
Pay-roll	$5,109 97
Subsistence	1,346 86
Fuel	554 29
Repairs	107 15
Office expenses	25
Stationery	55 01
	7,173 53

The survey referred to was made by Mr. F. S. Burrowes.

This gives all the data necessary for the estimates for the improvement of these shoals. To avoid repetition these estimates are all given under the general estimate for the permanent improvement of the Arkansas River, Arkansas and Kansas. The expense of this survey was:

Items:	
Pay-roll	$682 82
Subsistence	19 60
	702 42

Referring again to the general head of appropriation, the following is the money statement:

Money statement.

July 1, 1884, amount available	$7,875 95
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	7,875 95
Amount (estimated) required for completion of existing project	(*)

EXPENSE ACCOUNT IMPROVING ARKANSAS RIVER, ARKANSAS AND KANSAS, FOR YEAR ENDING JUNE 30, 1885.

Pay-rolls, labor, &c	$5,792 79
Subsistence supplies	1,253 60
General supplies	56 91
Stationery	65 01
Fuel	667 15
Lumber	40 24
Telegraph services	25
	7,875 95

* See "Removing obstructions in Arkansas River, Arkansas and Kansas."

V 3.

IMPROVEMENT OF ARKANSAS RIVER AT FORT SMITH, ARKANSAS.

In 1878 it was impossible for steamboats to reach the landing at Fort Smith at low water. During that year Major Suter built a brush and stone dike 1,100 feet long, projecting from the left bank a short distance above the mouth of the Potean River and extending parallel to the current, down-stream, 600 feet. This had the desired effect of carrying the main channel to the right bank near the mouth of the Potean River and deepening the channel at the Landing. In 1879 the portion of the dike parallel to the current was lengthened 400 feet additional. Width was given the dike and it was carried to a uniform height of 8 feet above low water.* This gave permanency to the results of the previous year, and no further appropriations were deemed necessary. The expense of this work was $19,695.49; $10,000 of this was appropriated by act approved June 18, 1878, the balance being an allotment from some general appropriation for the Arkansas River.

In April, 1884, Major Adams, in an examination of the town front found some slight erosion, and gave an estimate for repairing a few small dikes that had been constructed by private enterprise to prevent the dikes built in 1878–'79 from doing their work too well. This led to an appropriation of $5,000 by act approved July 5, 1884.

The project for the improvement of this harbor under this appropriation was adopted August 7, 1884, the object being to deflect the river in such a manner as to prevent the erosion of the banks along the town front. The report of the assistant in charge of this work, which is appended and marked A, gives so completely and correctly all the facts connected with it that it would be a waste of time and space to recapitulate the same. Recent reports from the locality show that the works have been most effectual in checking the erosion of the banks. No further extension of the works is required, and no further appropriations are recommended. Total amount of appropriations, $24,695.49.

Money statement.

Amount appropriated by act approved July 5, 1884	$5,000 00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	5,000 00

EXPENSE ACCOUNT.

The following is the expense account:

Services of assistant engineer, clerk, and laborers	$1,182 51
Stationery	23 67
Hardware	283 45
Brush, stone, poles, &c	3,184 67
Subsistence supplies	102 86
Hire of barge	146 96
Lumber	16 21
Oakum	5 32
Traveling expenses	53 85
Telegraph service	50
Total	5,000 00

*Just before forwarding this it has been learned that some repairs are needed. This will be investigated at once.—H. S. F.

A.—REPORT OF MR. FRANK D. LEWIS, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Little Rock, Ark., December 10, 1884.

CAPTAIN: I have the honor to submit herewith my report of operations under the appropriation for "removing obstructions in the Arkansas River, Arkansas and Kansas," applied to the "protection of the harbor at Fort Smith, Arkansas." The work contemplated under this head, as suggested in letter from Maj. M. B. Adams, Corps of Engineers, U. S. A., April 8, 1884, to the Chief of Engineers (see House Ex. Doc. No. 151, Forty-eighth Congress, first session), and as indicated in your project for this improvement July 29, 1884, consisted in increasing the size of the jetties already constructed by private enterprise (the Oil and Compress Company), and the construction of one additional jetty, with the end in view of deflecting the current of the river from the caving banks along the town front. In accordance with this general plan, and in obedience to your orders, Mr. W. L. Killebrew assumed charge of this work on the 20th of August, 1884, and, after a careful examination, recommended that the new jetty be located 600 feet *below* the steamboat landing and 600 feet *above* the uppermost of the two jetties previously constructed. The work of constructing this jetty by hired labor and purchase of material in open market, as authorized, was commenced September 11, 1884. Permission was secured from the governor of the Choctaw Nation for obtaining from the banks of the Potean and Arkansas rivers, in the Indian Territory, the brush, poles, and stone necessary for the prosecution of this work. The work was actively pushed under Mr. Killebrew's direction until October 13, when he was relieved from duty in connection with this work, and I assumed charge.

The new jetty was completed October 23, 1884. It extends into the river a distance of 181 feet, inclined slightly down-stream; is 40 feet wide at its base and 20 feet wide at the top, which is 12 feet above low-water mark. This jetty contains 44,590 cubic feet of brush and stone filling, in the construction of which there were used: 1,181.6 cords of brush, 58 cords of poles, and 767 cubic yards of stone, at a total cost for material and labor of $3,475.08. As soon as the completion of this new jetty had been accomplished, work was begun without delay upon the enlargement of the larger of the two original jetties. This jetty had already been carried by private enterprise a distance of 60 feet into the river. Under my direction, 40 feet were added to its length and 12 feet to its width, and it was raised to a height of 8 feet above low-water mark. This addition to the jetty contains 25,286 cubic feet of brush and stone filling, in the construction of which there were used 618.7 cords of brush, 45 cords of poles, and 317.4 cubic yards of stone. The completion of this work consumed in the payment for material and labor the entire balance remaining of the appropriation of $5,000 for this work. The entire work was completed, as planned, on the 8th of November, 1884. The property was then transferred to flat-boats and floated down the river in my charge to Little Rock, where it was duly accounted for and where I was relieved from duty in connection with this work. As both jetties now rest upon the rock-bed of the river, there is no doubt as to their permanency. The sand-bar on the opposite side of the river has been cut away between 300 and 350 feet, and the current has been deflected from the caving bank to the sand-bar, thus effectually preventing any further erosion of the bank.

I have the honor to remain, Captain,
Very respectfully, your obedient servant,

FRANK D. LEWIS,
Assistant Engineer.

Capt. H. S. TABER,
Corps of Engineers, U. S. A.

V 4.

IMPROVEMENT OF ARKANSAS RIVER AT PINE BLUFF, ARKANSAS.

This reach of river, which lies in the vicinity of Pine Bluff, Ark., was in a very bad condition prior to any attempts at improvement. At one point a cut-off was threatened which would change the slope of the river from three-fourths of a foot per mile to 4 feet per mile. At another point a bad bar interfered with navigation at low water, and in the sharp bend in front of the town of Pine Bluff the river was eroding

the banks with a rapidity that threatened to sweep the town from existence. The original project proposed to accomplish three objects, viz:

First. To protect the river bank in front of the town from further erosion.

Second. To rectify the course of the river in the bend above town in order to remove a bar now existing there, * * * and also by diminishing the curvature of the bend, to lessen the tendency to excessive scour in front of Pine Bluff.

Third. To prevent the formation of a cut-off now threatened across the peninsula opposite Pine Bluff * * * . The whole improvement to extend over 13 miles of river.

Up to June 30, 1884, $67,287.14 had been expended with the above objects in view; 3,900 feet of the town front, beginning at Brump's Bayou, was revetted during 1881; 3,700 feet of Yell's Bend was revetted the same year to prevent the cut-off, and a wire curtain dike, 1,110 feet long, was put in to affect the bar. In 1882, 3,000 feet more of Yell's Bend was revetted, and in 1883 the old works were repaired; 3,000 feet of bank in Yell's Bend was regraded, and 1,000 feet of high-water protection put in place. During the fiscal year ending June 30, 1884, little was done except to care for plant. July 1, 1884, there remained of all this work only the wire curtain dike. This result was predicted by the various engineers in charge, inasmuch as the works had to be left in an unfinished state, owing to failure of funds. The works in Yell's Bend had, however, a long enough life to delay the advance of the river until changes above rendered the danger less imminent. The wire curtain dike did good service and the bar was much improved. The town, however, was left at the mercy of the river.

During the high water of the spring of 1884, the front was eroded in places 120 feet and upwards, and it was apparent that if something could not be done the entire business portion of the town would have to move back or be swept away. By act approved July 5, 1884, $55,500 was appropriated for this work, and of this $49,139.73 has been expended in such a manner as to protect the entire front except the last two blocks. The works have endured two extraordinary rises and done their work well with no signs of weakness. These results were secured with seven points out of ten against success and by plans differing radically from the original project. This appropriation being again very small compared with the work to be done, the river was made to do its own work. A careful inquiry in regard to experiences of the past, with a study of the locality and a thorough examination of results had on the Mississippi, started the question as to how wide a revetting mattress should be, and as it appeared that it must have width enough to go entirely over the stratum of quicksand known to exist here and extend so far that it should reach a point where deposits begun or at least scour ceased, it became evident that there was not money enough to put in an effective revetment. Again it seemed that putting in a revetment was treating the effect and leaving the cause untrammelled to bring its full energy to bear upon the works of revetment. The conditions in general were as follows: Above the town was a bar, opposite the town a bend. The river in its course above the town as it reached the bar unloaded its sediment, and flowing over the bar proceeded with accelerated velocity and comparatively free from sediment to attack the bend. Now it seemed clear that the problem of protecting the town front resolved itself into obliging the river to cut out the bar or the opposite bank, and to go loaded by the town or to be made to drop some of its load in front of the town, in other words to produce an arti-

ficial bend with caving banks, where it could do no harm, and throw in an artificial bar where it was much needed. Thus two things would be accomplished, the river being well loaded could not scour out the quicksand and every particle of its load that it lost in passing the town front would be so much thrown down upon the quicksand to hold it in place. The solution of the problem, as stated, seems simple and practical, and the results show that it was correct, as they are in excess of my most sanguine expectations, but the details of its solution required most heroic measures and the most careful closing up of the ranks. The river is subject to sudden rises, and as its turn here is less than a right angle by, say, 22 degrees, and as it sweeps in a straight reach 4 miles or more down upon the works, it bears down at flood with terrific force, bringing acres of drift, and with a force that no ordinary dike could withstand.

The first thing done was to secure an assistant engineer who was known to be a lion-hearted builder, and who would carry out orders to the letter. Next material was accumulated so that there could be no delay, and the assistant was made thoroughly acquainted with the dangers incident to a rise. A careful comparison of the river with old maps showed that the bar to be cut out was forming down stream very rapidly. Taking advantage of the well-established fact that a river can be trusted to go on adding to such a bar, and consequently to works located upon it, Dike No. 1 was laid down upon it, as indicated upon the accompanying sketch. This dike was calculated to subserve three purposes:

First. It would check the velocity of the flood and keep the river from its work along the upper town front; plainly, from the sketch, a stand must be made here, or all works below would be attacked in the rear.

Second. It was laid upon the middle of an $\overset{a}{S}_{b}$ curve, along the line *a—b*, so that catching the current on a change it would deflect it powerfully from the town.

Third. By its length and its height, 12 feet above mean low water, it would crowd 12 feet of a flood into a narrow space upon the bar, cut it out and also the opposite bank and load the river with sediment, as desired. Having decided that the fight must be made upon this line, resources were again studied, and after corresponding with owners of quarries, I found that if stone were used for weighting mattresses and filling in dikes, the entire appropriation would not buy stone enough to do two-thirds of the work. The cheapness of lumber, combined with the fact that all the works, if successful, would be soon buried, led me to ask authority to use cribs or boxes filled with sand, in lieu of stone. This being approved, a saving of 50 per cent. was assured and a great gain made, inasmuch as by no possible means now could there be any failure to have weighting material on hand when needed, and it was found still further, in sinking mattresses, the boxes remained in place better and could be handled cheaper than stone. As required by the approval from the Office of the Chief of Engineers, a thorough test was made of several cribs or boxes loaded with sand before the work was finally pushed forward. Referring to the sketch, it will be seen that no ordinary dike would be likely to withstand the flood next the shore. The cross-section shown at A on Plate 1 was finally adopted as being most likely to give the necessary stability, and a section extending from the shore to X on the plan was built with this cross-section.

A well-woven mattress, 120 feet wide, was first laid and weighted with boxes filled with sand, with a weight equivalent to 5 cubic feet of stone to every 10 square feet of mattress. Another narrower mattress was then laid over this, with a layer of boxes filled with sand, and so on until a height of 12 feet above mean low water was reached. Special care was given to revet the bank above and below the shore end up to high-water mark.

When this section was completed the bottom mattress was narrowed to 100 feet and the dike prolonged as a pile, brush, and stone dike, sand boxes being substituted for stone. As it seems pretty well settled that no pile will stand in an alluvial stream with much current without a heavy foot-mat extending at least 40 feet all around it, positive orders were given to always keep the foot-mat well weighted and completed 50 feet ahead of the piles. The piles were driven in two rows 8 feet apart in the row and 12 feet between the axis of the rows, and well braced with waling pieces, horizontal and diagonal cross-braces. The weight of sand-boxes used in filling was somewhat less than the weight used on the first section. The wisdom of keeping everything well in hand and especially of keeping a foot-mat beyond the completed end of the dike as it advanced was abundantly demonstrated in the latter part of December, 1884, when an unexpected and unprecedented rise occurred. Through the courtesy of the Chief Signal Officer I was kept informed of rises at Fort Smith whenever they amounted to over 2 feet. The rise in question was telegraphed me as unusual, and orders were telegraphed to Pine Bluff to prepare for it. By means of a locomotive headlight parties worked day and night for two days, and by the time the flood came all appliances were afloat and property secured. The dike was extended to only a little over one-half its length. The river piled acres of drift above it and ran along under this drift and upon the foot-mat at such a rate that a powerful pile-driver could not be corbelled up against it, and finally the drift went over, leaving the dike intact. Eventually the dike was under over 15 feet of water. The effects upon the bar and the opposite bank were without parallel in the experience of river men; 175 feet of the bank was caved in on the side opposite the town, in a direction at right angles to the channel, and the channel just below the dike was changed over 600 feet from the town side toward the opposite bank. In one week steamboats were passing where, at the beginning of the rise, there had been a heavy growth of cottonwood timber. No caving took place along the town front. Up to this flood the plans had been upon the principle of three lines of battle, provision having been made for a second dike and also a certain length of revetment, so that three lines would have to be overthrown before the town front could be swept. The rise having developed the fact that the methods of construction adopted had the requisite strength to resist the force of the flood, and also having, as was expected, thrown a bar below it well along the town front, and as this artificially-produced bar was growing down like the parent bar, so to speak, it appeared that it was now possible to protect the entire town front by placing a dike upon the lower end of this artificial bar. As the water was still very deep here great precaution was used in construction. Work was kept steadily moving upon the upper dike, and the lower was pushed as fast as possible. When 56 feet only had been completed quite a serious rise occurred. So rapid was the deposit that when the water went down and work was resumed a fill of over 10 feet was found at the outer end of the dike. By dint of vigorous work and constant guarding against rises, this dike was eventually com-

pleted to 250 feet. To give further protection against scour, as it will be seen from the sketch that the dike is in a very trying place, an old scow was sunk opposite the upper corner. This dike has the same foot-mat as Dike No. 1, only it is loaded a little heavier. The plates give very good ideas of the details of the two dikes. The upper dike was pushed along and finally successfully completed. Scarcely were the two dikes well finished when, as was expected, the heavy spring rise came down. Ordinarily this is a gradual rise. In this case, however, it was very sudden. In spite of doing a great deal of damage all along the river, it had no effect upon the dikes. A terrific strain was brought upon Dike No. 2, which it withstood.

No caving of the town front excepting such as must take place to bring the vertical banks to the natural slope occurred, except at the extreme lower end of the town. At medium stages of water there is an eddy or still water along the entire town front. At high water, of course, the increased velocity due to the fall over the submerged dikes causes quite a current next the bank below Dike No. 2, but as the upper portions of the bank are of a kind of soil not eroded no harm results. In former years the caving has all taken place while the river was dropping from a medium to a low stage, due evidently to an erosive action at that time. The dikes have so affected the river as to deflect the current from the banks from medium to low-water stage, and to cause deposit instead of scour along the entire front, except about two blocks at the extreme lower end of town. The river has responded well to the demands made upon it, and though the elements dealt with were large, in one instance the results were so clear that the entire current of the Arkansas River was thrown within 50 feet of the point it was expected it would reach. The completion of Dike No. 1 caused a still further erosion of the opposite bank, which in turn caused greater deposits around and below No. 2, and deprived the river of its power of taking up much sediment while passing the town. Since the river has again fallen the works are all found intact, and enormous deposits are shown and everything indicates that the works will have great permanency. As was expected, they are well buried under, and having done their work the cheap material which gave them their dead weight is as effective as though it had been the solid rock.

Notwithstanding all the signs of permanency, the well-known fact that these delta-like streams change condition very rapidly seemed to render it advisable to hold a certain contingent until time should have passed in which to develop these changes. To give the entire town protection will require $8,000 more to construct two small dikes lower down, or, perhaps, three, which of course can be very light, simply to act as aids to deposit by checking the velocity. If it should be asked why this was not provided for in the present development of the work, it may be answered that at the original estimate a sufficient length of dike has been built to cost $69,000, whereas it actually cost only a little over $48,000. It took more linear feet of dike than was estimated to do the work; yet this has been built, and a work wrought that it was believed to be well nigh impossible to accomplish, which has been attempted several times without success, and still enough money is held to do the balance; only, as a precautionary measure, it would seem best to hold it awhile to make good what has already been done, if necessary. The success of this work is largely due to the liberality of certain citizens of Pine Bluff, in furnishing the brush at a nominal price, and specially due to the energy, perseverance, good judgment, and cool-headedness of Mr. S. P. Adams, the assistant engineer in charge. He was tireless in his

efforts to cope with the elements he found opposing him, studied practical economy, and knew how to strike when the time had come. When called upon to part with him, as I did very reluctantly, he was succeeded by a very deserving young engineer, Mr. E. F. Officer, who pushed the work in the same general way to a successful issue. I visited the works very frequently, but principally to lay out work, either of these gentlemen proving themselves perfectly competent and reliable as to details. The result of their labors is a splendid triumph of engineering skill, as they fought their way step by step, having to guard daily against unforeseen contingencies, and the fact that their work stands shows that they were faithful in the execution of their trust, as a neglect anywhere would have been fatal to the whole. Mr. Adams's report is appended and marked C. Mr. Officer's report is appended, marked A. This report has been made somewhat more extended than others, inasmuch as the plans for the management of certain other reaches of the river are largely based on successes here, and it was deemed advisable to show that the effects secured here were not the results of chance, but were studied and wrought out in detail from examining the works on the Mississippi and Missouri, and taking the best results there secured so far as they were applicable. The main credit for all this work lies with the able officers in charge of improvements upon those rivers, who have laid down in their reports for the past few years such valuable data respecting alluvial streams. I am indebted to the works in Galveston Harbor for the first 400 feet of Dike No. 1. A reference to the sketch will show that while it breaks the flow very gradually by its peculiar cross-section and thus prevents the rapid scour below due to a vertical overfall, it at the same time affords an effective barrier, 12 feet high, and has along its upper face a foot-mat to receive the current along that face, and thus prevents the scour due both to the current and the pressure brought upon the current by the accumulated drift which must lie above the dike until the flood has attained nearly a 15-foot stage. In this instance, as was noted, the current was so swift that a new pile-driving engine could not corbel a light pile-driver against it. It will be noted that this dike was built from the shore out instead of being built in two sections. This was decided upon in view of the disasters to Mississippi River dikes from unexpected floods coming before the gap between the two sections had been closed. The life of both the dikes is due to the broad, well weighted foot-mats, which have withstood the scour, and these valuable adjuncts themselves are the result of a fortuitous combination of cheap brush and poles, and sand-boxes, also astonishingly cheap when their marked effectiveness is considered. Too great stress cannot be laid upon the decision made by the Chief of Engineers by which these two elements were rendered available, and also upon the latitude given the local engineer to use either dikes or revetment, or both, as the contingencies of the works demanded.

In passing it may be well also to note that the success of these works well illustrates the great advantage of giving in one appropriation the amount required to complete the work. A reference to the reports of my predecessors will show a long line of predictions well fulfilled of the loss of the entire work because left uncompleted through lack of funds, and it is perhaps my duty to say that from the results now visible had the first two appropriations been made as one, amounting to $48,000, the amount expended this year, apparently the last two, amounting to $75,000, would not have been required. Since the preparation of the earlier pages of this report the upper dike has continued to put in effect.

ive work in the way of caving the opposite bank, until it now seems possible that eventually the current's point of infringement upon the bend along the town front can be moved entirely below the town. So effectually has the upper dike done its work that it is now an immense sand-bar, the bar even extending beyond its extreme end. It will be borne in mind that this extreme end extends 100 feet or more over the channel of July 1, 1884. It is most earnestly urged in view of these facts that the recommendations contained in my letter to your office in response to the Senate resolution of February 25, 1885, relative to a contingent fund, be carried out, as it is evident now that a very small outlay judiciously made will maintain this very bad reach of river in good condition for navigation, and afford ample protection to the town.

It is my duty to add, however, that if this outlay is not provided for, the never-ceasing changes that are going on in all delta-like streams will eventually take such form as to practically nullify all that has been done heretofore, and render enormous appropriations again necessary to aid navigation and protect the town. So important is this matter that I have decided to append that letter and mark it "B," that it may not be separated by any chance from this important matter.

Plate III, forwarded herewith, is designed to show the position of the dikes and the changes produced by them. The references will give a better understanding of this subject than pages of written matter could do.*

Money statement.

July 1, 1884, amount available		$712 86
Amount appropriated by act approved July 5, 1884		55,500 00
		56,212 86
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$48,639 73	
July 1, 1885, outstanding liabilities	174 25	
		48,813 98
July 1, 1885, amount available		7,398 88
Amount that can be profitably expended in fiscal year ending June 30, 1887 Submitted in compliance with the requirements of section 2 of river and harbor acts of 1866 and 1867.		8,000 00

EXPENSE ACCOUNT. ARKANSAS RIVER, PINE BLUFF, FOR THE YEAR ENDING JUNE 30, 1885.

Pay-roll, men and teams	$36,143 05
General supplies	3,765 48
Office rent	153 80
Stationery	97 17
Traveling expenses	104 44
Lumber and piles	8,259 29
Fuel	563 95
Oars	24 45
Furniture	19 10
Skiff	15 00
Telegraph service	7 00
	49,139 73

*Just prior to mailing this report, word was received of erosions between X and Y, Plate III, amounting to upwards of 100 feet measured at right angles to the channel.

Plate I Appendix IX

Designed to accompany Capt. H.S. Taber's Annual Report to the Chief of Engineers.

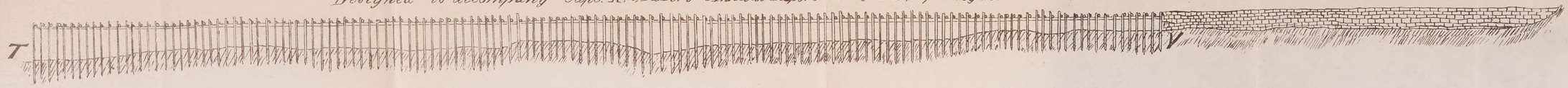
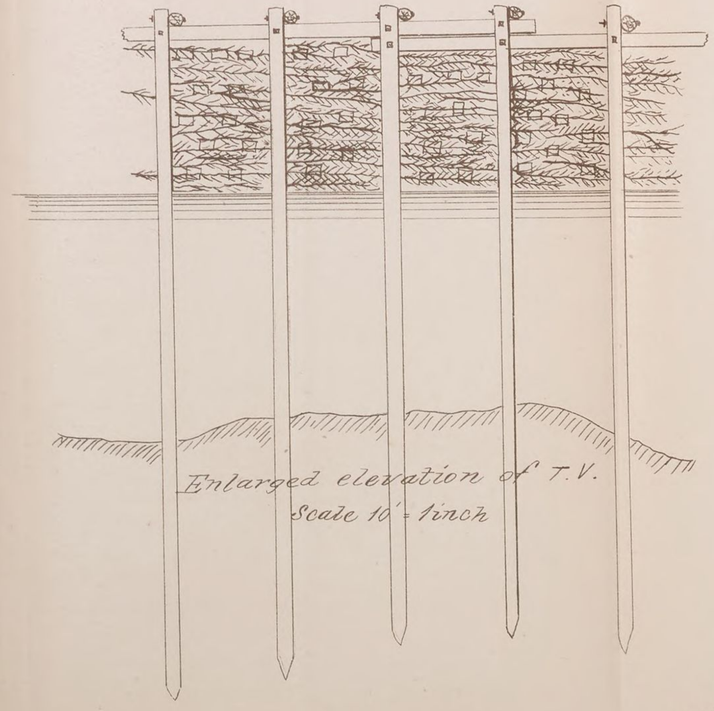
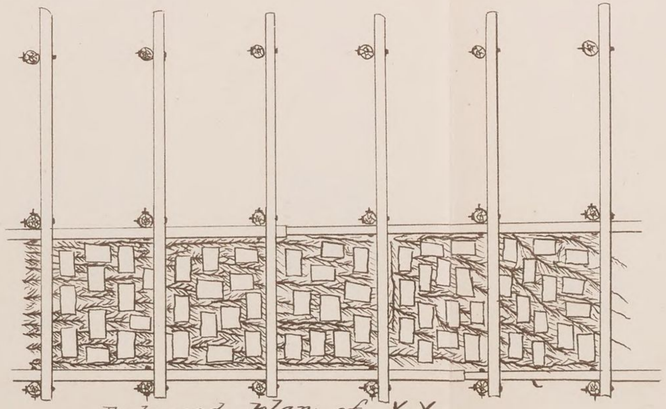


Fig 1. Elevation of Dike No. 1 Scale 100 ft. = 1 inch

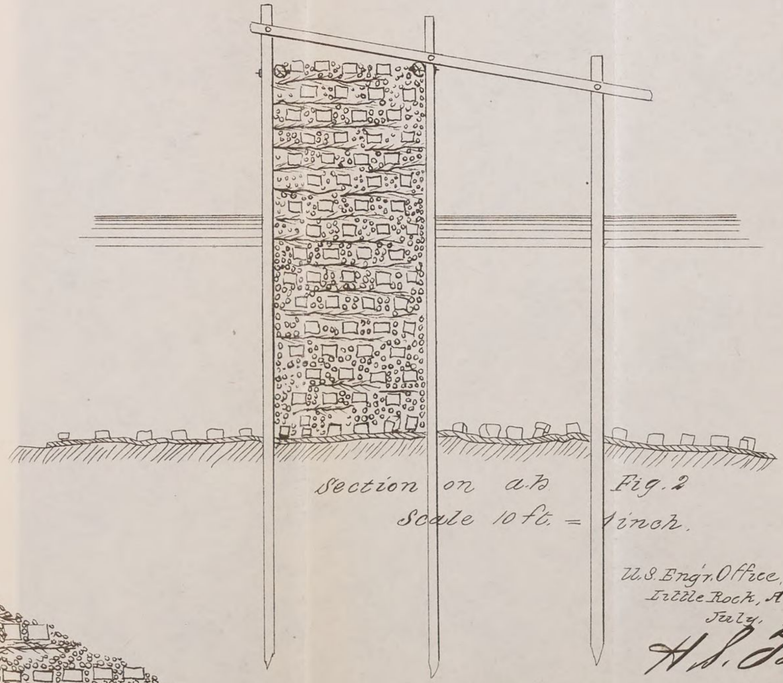
Fig 2 Plan of Dike No. 1 Scale 100 ft. = 1 inch



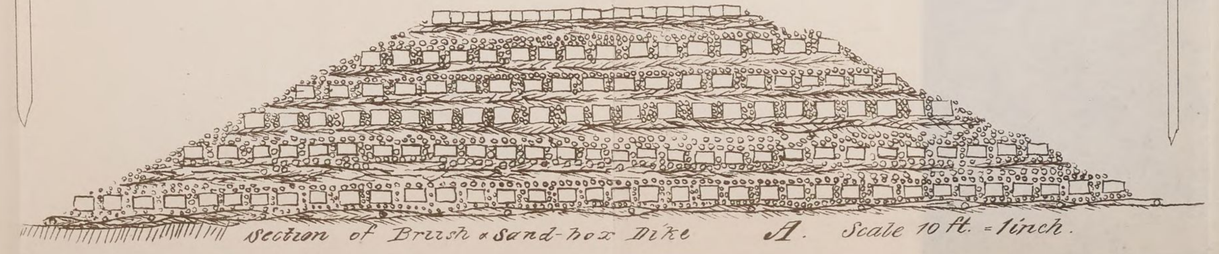
Enlarged elevation of T.V.
Scale 10 = 1 inch



Enlarged plan of X.Y.
Scale 10 ft. = 1 inch



Section on a b Fig. 2
Scale 10 ft. = 1 inch.

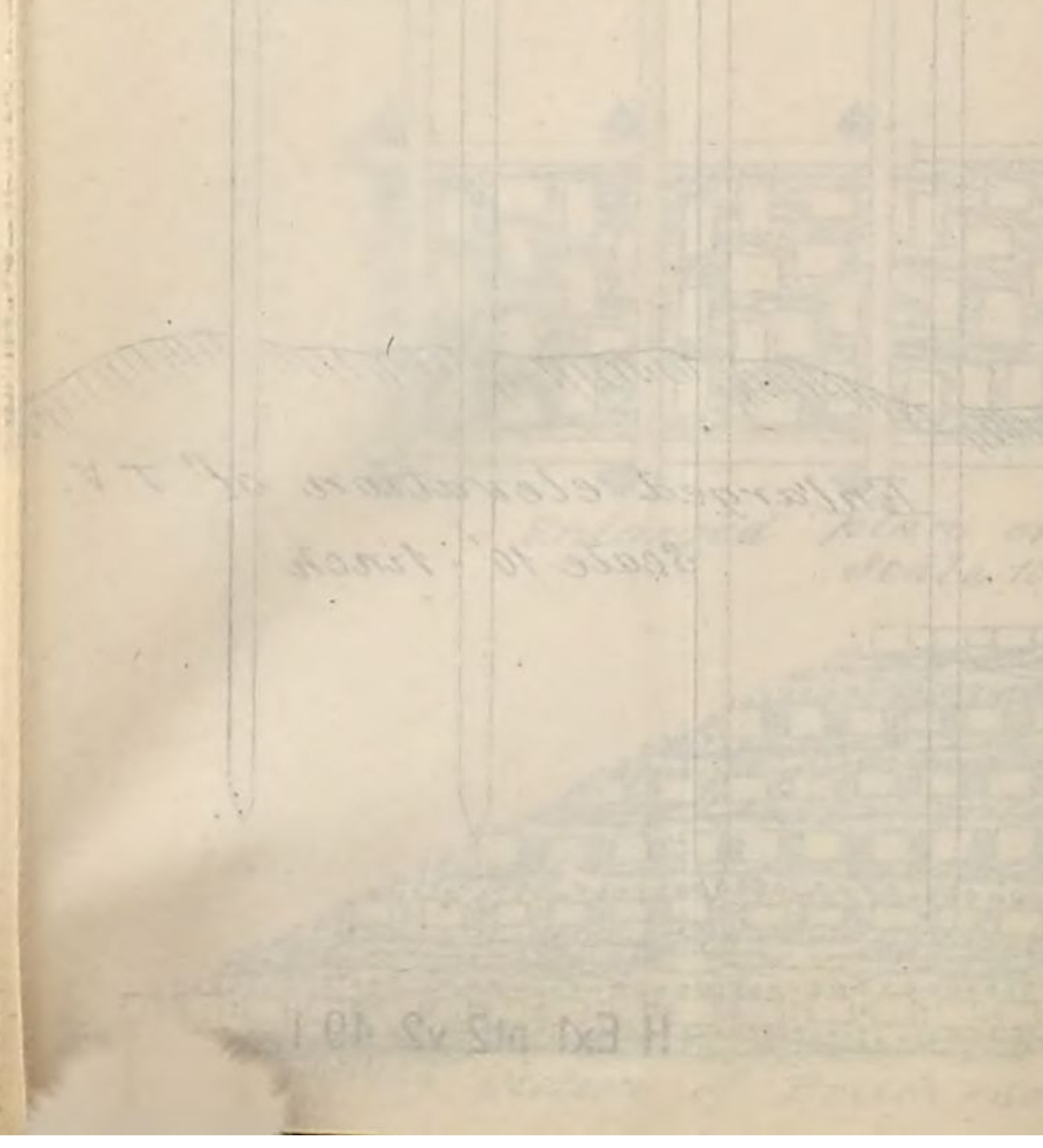


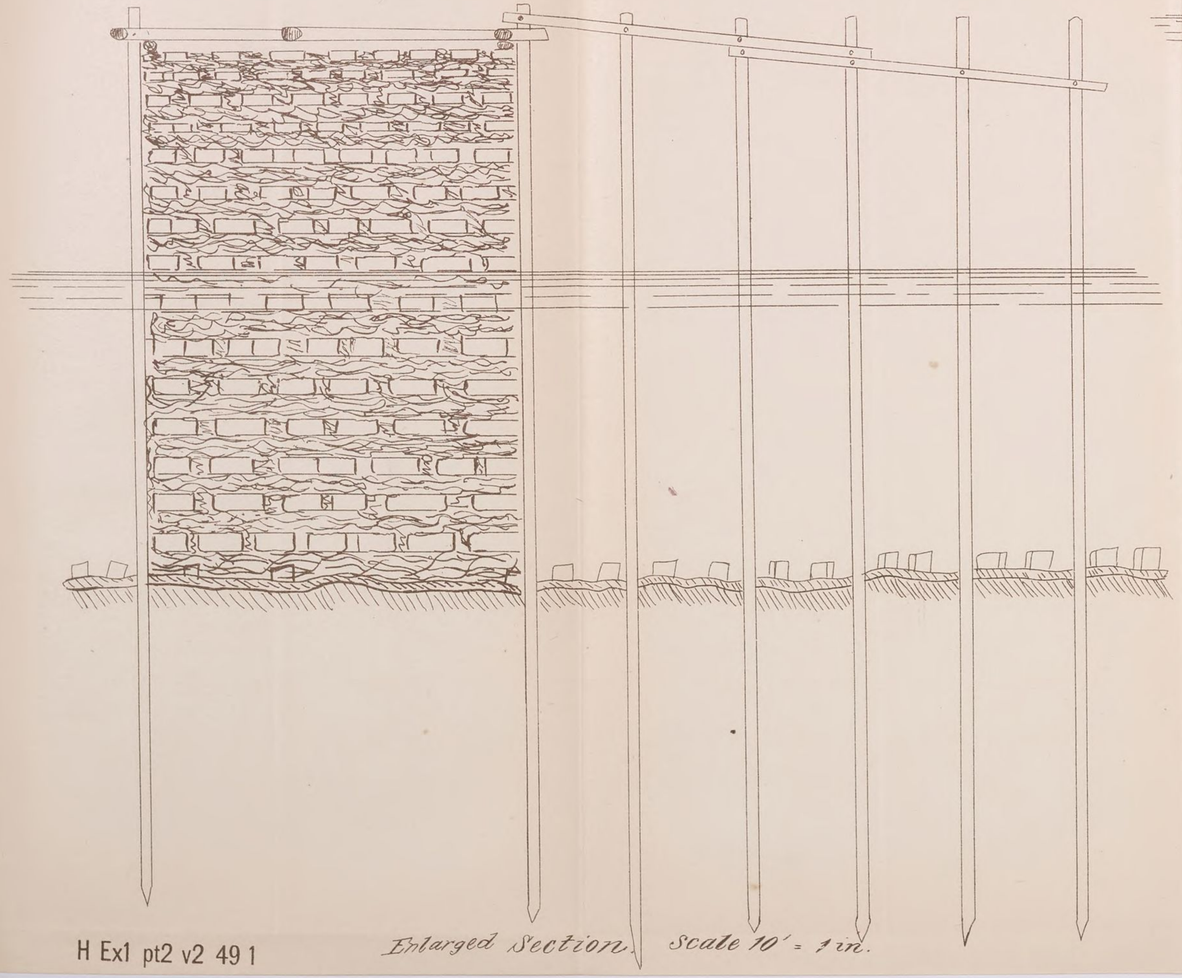
Section of Brush & Sand-box Dike A. Scale 10 ft. = 1 inch.

U.S. Engr. Office,
Little Rock, Ark
July, 1885

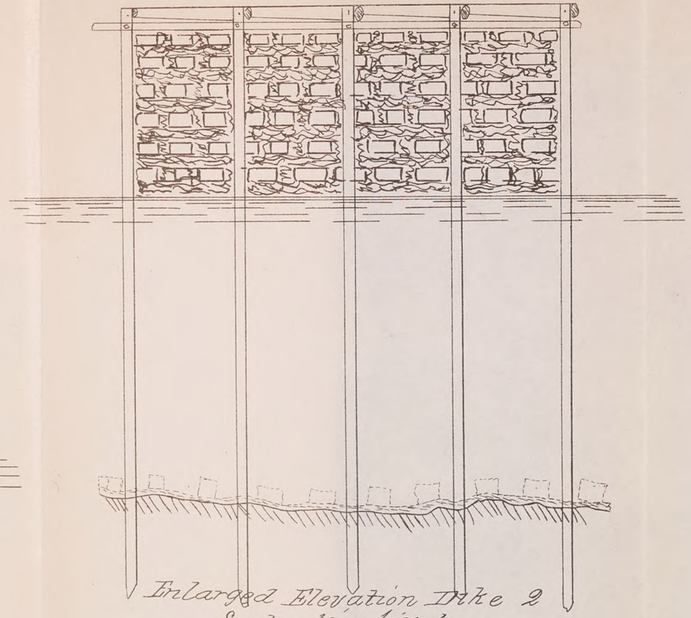
H.S. Taber,
Capt of Engrs

H Ex1 pt2 v2 49 1

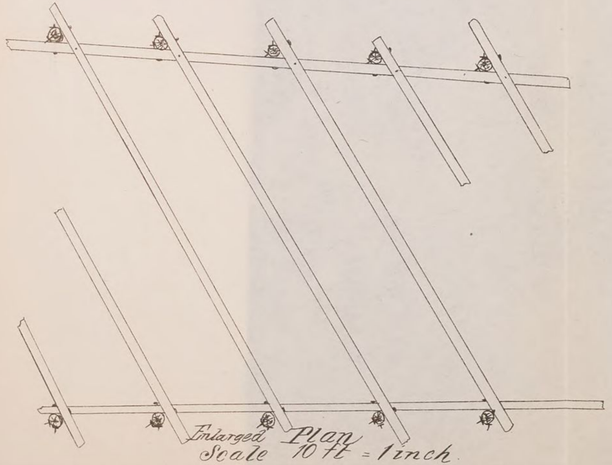




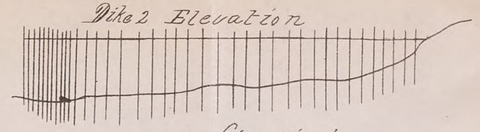
Enlarged Section. Scale 10′ = 1 in.



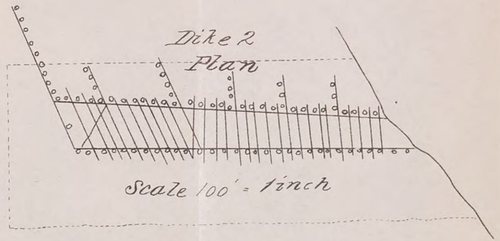
Enlarged Elevation Dike 2
Scale 10′ = 1 inch



Enlarged Plan
Scale 10 ft = 1 inch



Dike 2 Elevation
Scale 100 ft = 1 inch



Dike 2
Plan
Scale 100′ = 1 inch

Plate II. Appendix IX.

Designed to accompany Capt. H. S. Taber's Annual Report to the Chief of Eng'rs.

H. S. Taber.
Capt. of Engineers.

H Ex1 pt2 v2 49 1

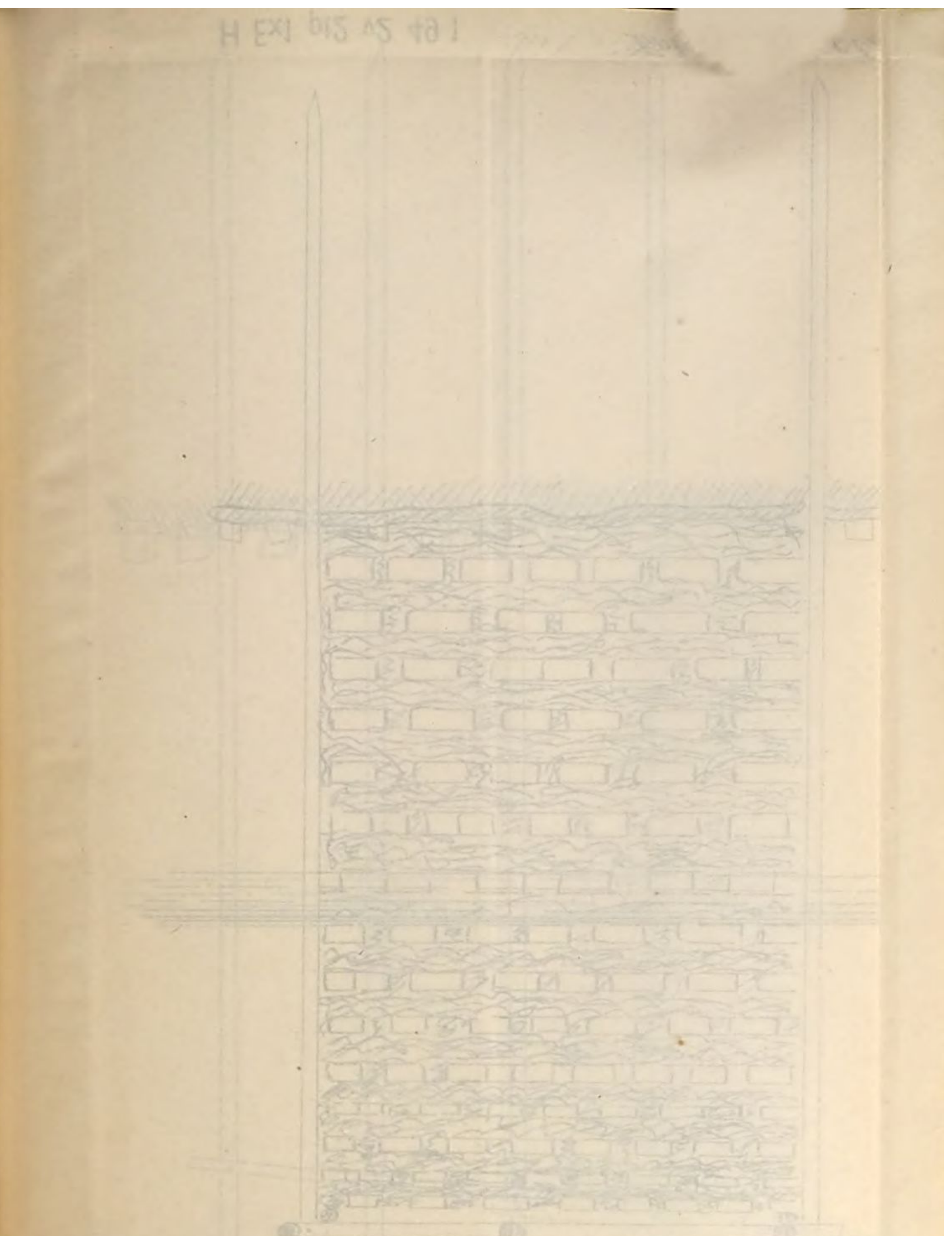


Plate III.
Appendix IX

Map
OF THE
ARKANSAS RIVER
IN THE VICINITY OF
Pine Bluff, Arkansas.

Made under the direction of
CAPTAIN H.C. TABER
Corps of Engineers, U.S.A.
July 1885.

Scale - 1/6000.

Designed to accompany Capt. H.C. Taber's Annual Report to the Chief of Engrs.

REFERENCE

- Channel, January, 1881.
- Channel, April, 1885.
- Sandbars, 1881.
- Sandbars, 1885.
- Shore line, 1881.
- Shore line, 1885.

Soundings in red taken September, 1884.
Soundings in black taken April, 1885.
Soundings reduced to a 20' stage of water.

H. C. Taber,
Capt. of Engineers.

H Ex1 pt2 v2 491

A.—REPORT OF MR. E. F. OFFICER, ASSISTANT ENGINEER.

PINE BLUFF, ARK., *April* 27, 1885.

SIR: I have the honor to submit the following report of operations at this place for the period extending from February 26, 1885, to April 20 1885. The object of the work was to stop the caving of the town front, which had been going on for a great while previous. During the autumn of 1884 two dikes had been located, extending out and diagonally down-stream from the south bank of the river. The upper dike (No. 1) had been carried out to a distance of 1,304 feet from shore, and the lower dike (No. 2) 96 feet from shore.

Dike No. 1.—The shore end of this dike is about 600 feet above Brump's Bayou. The dike consists of three parallel rows of piles driven 12 feet apart, the distance between the piles in each row being 8 feet. Longitudinal stringers, at a height corresponding to a 22-foot stage of the river, were bolted on the upper and middle rows, after which the space between was filled with alternate layers of brush and boxes filled with sand up to the height of the stringers. Cross-braces were then bolted to the piles perpendicular to the rows, and extended back to the lower rows, to which they were also bolted. Underneath the whole structure a foundation mattress, 120 feet wide, was placed. This mattress extends 60 feet above and 60 feet below the upper row of piles, and 50 feet beyond the ends of the rows in the direction of the dike. The mattress was woven on a barge, previously constructed for that purpose, and, after being launched on the water, was sunk to the bottom with sand-boxes. This dike was extended 216 feet, to do which eighty line piles were driven, besides two mooring piles, for holding the mattress in position, and fifty braces and ten longitudinal stringers were placed and bolted. The piles were driven to a depth of from 18 to 20 feet below the bottom of the river, and the braces and stringers were secured to these by 1-inch screw-bolts. Between the rows, as filling, there were placed 84 cords of willow brush, previously cut and hauled; 30 cords of pine brush, previously cut and hauled; 586 cords of new brush, cut, loaded on barges, and towed to the work; also, 2,752 sand-boxes, previously manufactured; 110 linear feet of foundation-mattress were woven with new brush and sunk with 634 sand-boxes, previously manufactured. The cost of this 216 linear feet of dike was:

For labor	$2,208 34
For material	1,696 45
Total	3,904 79

Dike No. 2.—This dike is located about one-quarter of a mile below No. 1, and was extended 155 feet, making its total length 251 feet. A foundation-mattress 120 feet wide, similar to that under dike No. 1, had been previously laid, and extends 50 feet beyond the outer end, or 301 feet from the shore. This dike consists of only two rows of piles, 20 feet apart at the shore end, and gradually widening to the outer end, where the distance is 36 feet. The piles, which are 8½ feet apart in the rows, are braced with longitudinal stringers and cross-braces, secured by screw-bolts. The space between the rows is filled to the same height, in the same manner and with the same material as dike No. 1. This dike is braced from the lower side with six short perpendicular lines of piles, with stringers bolted to their tops and extending to the dike. To give the dike additional strength, there were stretched three 1-inch wire cables from points 85 feet, 170 feet, and 251 feet from shore, respectively, to piles driven in the bank above. To extend the dike, as above described, fifty-nine piles were driven, and forty-two braces and fourteen stringers were placed and bolted. One section of mattress 60 feet by 42 feet was built above the line, and extends up the bank. The other mattress had been laid previously. Between the rows there were placed 349 cords of willow brush, previously cut and hauled; 57 cords of pine brush, previously cut and hauled; 710 cords of new brush, cut, loaded on barges, and towed to the work; also 4,711 sand-boxes, which were manufactured from lumber on hand. The cost of this 155 linear feet of dike was:

For labor	$3,961 21
For material	2,079 01
Total	6,040 22

MATERIAL.

The piling used was yellow pine. It was furnished by contract, which required that it should be straight and not less than 8 inches in diameter at the small end.

The brush used consisted of 441 cords of willow and 107 of pine, which had been previously cut and hauled, the former costing $1.574 and the latter $1.0343 per cord delivered in the vicinity of the box factory on the bank. There were also 1,409 cords

of new brush cut and towed to the work, at a cost of $995.34, or slightly under 71 cents per cord.

The cost of loading and delivering old brush to the work was 25 cents per cord in addition to the above figures. The boxes, which were filled with sand and used as a substitute for stone, were constructed of 1½-inch pine and red-oak lumber. They were made two sizes. The following statement is submitted:

Large size, 2′ × 3′ × 1½′. Of these there were 747 received from my predecessor, and the same now remain on hand. Small size, 12″ × 15″ × 21″ in the clear.

Number received	3,605
Number of these used	3,605
Number constructed	5,601
Number of these used	4,782
Number now on hand	819

Lumber required to construct one box, 18¾ feet, B. M.
Nails required to construct one box, 1 pound.
Cost of material per box, 19 cents.
The cost of the labor is shown in that statement
The following material was used:

Material.

Kind.	Dike No. 1.			Dike No. 2.			Total.		How used.
	Quantity.	Rate.	Amount.	Quantity.	Rate.	Amount.	Quantity.	Amount.	
Piling ..... sticks..	80	$0.05	$157 65	25	$0.05	$70 00	105	$227 65	Line piles.
Piling ..... feet..	3,153			1,400			4,553		
Piling ..... sticks..	2	.05	5 00	.....	.....	.....	2	5 00	Mooring piles.
Piling ..... feet..	100			.....	.....	.....	100		
Piling ..... sticks..	.....	.....	.....	34	(*)	.....	34	(*)	
Piling ..... feet..	.....	.....	.....	1,610	(*)	.....	1,610	(*)	Line piles.
Piling ..... sticks..	34	.05	58 25	35	.05	41 00	69	99 25	Braces.
Piling ..... feet..	1,165			820			1,985		
Piling ..... sticks..	16	(*)	.....	21	(*)	.....	37	(*)	
Piling ..... feet..	490	(*)	.....	950	(*)	.....	1,440	(*)	Braces.
Old willow brush ..... cords..	84	1.574	132 22	349	1.574	549 32	433	681 54	Filling between rows.
Old pine brush ..... do....	30	1.0393	31 03	57	1.0393	58 95	87	89 98	
Old new brush ..... do....	586	(†)	.....	710	(†)	.....	1,296	(†)	
Boxes of sand ..... number..	2,752	3.114	856 97	.....	.....	.....	2,752	856 97	
Boxes of sand ..... do....	.....	.....	.....	4,711	.19	895 09	4,711	895 09	
Bolts, screw ..... do....	223	.04	77 36	147	.04	50 04	370	127 40	Bracing dike.
Washers ..... pounds..	1,934			1,251			3,185		
Old willow brush ..... cords..	.....	.....	.....	8	1.574	12 59	8	12 59	Constructing foundation-mattress.
Old pine brush ..... do....	.....	.....	.....	20	1.0343	20 69	20	20 69	
New pine brush ..... do....	113	(†)	.....	.....	.....	.....	113	(†)	
Rope, manilla ..... pounds..	350	.14	49 00	300	.14	42 00	650	91 00	
Nails, 12d ..... do....	200	2.58	5 10	100	2.55	2 55	300	7 65	
Boxes of sand ..... number..	634	3.114	197 43	114	.3114	35 50	748	232 93	Sinking foundation-mattress.
Boxes of sand ..... do....	.....	.....	.....	71	.19	13 49	71	13 49	
Boxes of sand ..... do....	.....	.....	.....	105	.3114	32 70	105	32 70	Sinking old barges.
Wire cable, 1-inch ..... feet..	.....	.....	.....	1,000	1.11	111 00	1,000	111 00	Strengthening dike.
Wood ..... cords..	40	2.037	81 36	45	2.037	91 53	85	172 89	Supplying material.
Coal ..... tons..	2	5.25	10 50	4½	5.25	22 05	6½	32 55	Driving piles.
Wood ..... cords..	17	2.037	34 58	15	2.037	30 51	32	65 09	
Totals	.....	.....	1,696 45	.....	.....	2,079 01	.....	3,775 46	

*This piling was reported by Mr. Adams as expended.

†Cut by hired labor.

LABOR ACCOUNT.

General supervision:		
Assistant engineer, 33½ days, at $150 per month	$167 50	
Assistant engineer, 14 days, at $125 per month	58 33	
Foreman, 3 days, at $90 per month	9 00	
		$234 83
Inspection:		
Assistant engineer, 2 days, at a $150 per month		10 00
Observations and surveys:		
Assistant engineer, 7 days, at $150 per month	35 00	
Assistant engineer, 2 days, at $125 per month	8 33	
Laborers, 16 hours, at 15 cents per hour	2 40	
		45 73
Office work:		
Assistant engineer, 14½ days, at $150 per month	72 50	
Assistant engineer, 12 days, at $125 per month	50 00	
Receiver, 26 days, at $90 per month	78 00	
Foreman, 1 day, at $65 per month	2 17	
Time-keeper, 8 days, at $60 per month	16 00	
Water-boy, 152 hours, at 8 cents per hour	12 16	
		230 83
Tools and appliances:		
Carpenter, 35 hours, at 25 cents per hour		8 75
General repairs:		
Machinist, 29 hours, at 35 cents per hour	10 15	
Blacksmith, 85 hours, at 25 cents per hour	21 25	
Carpenters, 525 hours, at 25 cents per hour	131 25	
Carpenters, 10 hours, at 20 cents per hour	2 00	
Carpenters, 20 hours, at 17½ cents per hour	3 50	
Blacksmith's helper, 78 hours, at 17½ cents per hour	13 65	
Laborers, 20 hours, at 15 cents per hour	3 00	
		184 80
Repairing pile-driver:		
Machinist, 174 hours, at 35 cents per hour		60 90
Repairing steamer Picayune:		
Carpenters, 60 hours, at 25 cents per hour		15 00
Constructing skiffs:		
Carpenters, 30 hours, at 25 cents per hour		7 50
Constructing bolts:		
Blacksmith, 30 hours, at 25 cents per hour		7 50
Loading old brush:		
Carpenters, 150 hours, at 17½ cents per hour	26 25	
Laborers, 808 hours, at 15 cents per hour	121 20	
		147 45
Cutting, loading, and delivering new brush:		
Assistant engineer, 5 days at $125 per month	20 84	
Foreman, 3 days, at $90 per month	9 00	
Foreman, 39½ days, at $75 per month	98 75	
Engineer, 36 days, at $75 per month	90 00	
Foreman, 19½ days, at $65 per month	42 25	
Fireman, 200 hours, at 20 cents per hour	40 00	
Boatman, 15 hours, at 20 cents per hour	3 00	
Carpenter, 5 hours, at 20 cents per hour	1 00	
Carpenter, 20 hours, at 25 cents per hour	5 00	
Carpenter, 330 hours, at 17½ cents per hour	57 75	
Laborers, 4,185 hours, at 15 cents per hour	627 75	
		995 34
Piles:		
Receiving, receiver, 6 days, at $90 per month	18 00	
Hauling, teamster and team, 186 hours, at 30 cents per hour	55 80	
Pointing, carpenter, 105 hours, at 20 cents	21 00	
		94 80
Fuel:		
Receiving, receiver, 6 days, at $90 per month	18 00	
Hauling, teamster and team, 167 hours, at 30 cents per hour	50 10	
Cutting, laborers, 120 hours, at 15 cents per hour	18 00	
Loading, laborers, 105 hours, at 15 cents per hour	15 75	
		101 85

Constructing, delivering, and filling boxes:		
Assistant engineer, 1 day, at $150 per month	$5 00	
Foreman, 2 days, at $90 per month	6 00	
Foreman, 1 day, at $75 per month	2 50	
Engineer, 1 day, at $75 per month	2 50	
Foreman, 13 days, at $65 per month	28 17	
Carpenters, 73 hours, at 25 cents per hour	18 25	
Carpenters, 69 hours, at 20 cents per hour	13 80	
Carpenters, 489 hours, at 17½ cents per hour	85 75	
Laborers, 7,678 hours, at 15 cents per hour	1,151 70	
		$1,313 49
Care of property:		
Foreman, 8 days, at $90 per month	24 00	
Foreman, 27½ days, at $75 per month	68 75	
Engineer, 21½ days, at $75 per month	53 75	
Foreman, 5½ days, at $65 per month	11 92	
Foreman, 6 days, at $55 per month	11 00	
Watchman, 50 days, at $50 per month	83 83	
Fireman, 130 hours, at 20 cents per hour	26 00	
Carpenters, 135 hours, at 20 cents per hour	27 00	
Carpenters, 30 hours, at 17½ cents per hour	5 25	
Laborers, 1,115 hours, at 15 cents per hour	167 25	
		478 25

DIKE NO. 1.

Driving piles:		
Foreman, 2½ days, at $90 per month	7 50	
Carpenters, 40 hours, at 25 cents per hour	10 00	
Carpenters, 15 hours, at 20 cents per hour	3 00	
Fireman, 30 hours, at 20 cents per hour	6 00	
Carpenters, 370 hours, at 17½ cents per hour	64 75	
Water boy, 64 hours, at 8 cents per hour	5 12	
		96 37
Bracing:		
Foreman, 5 days, at $90 per month	15 00	
Carpenters, 286 hours, at 25 cents per hour	71 50	
Carpenters, 10 hours, at 22½ cents per hour	2 25	
Carpenters, 115 hours, at 20 cents per hour	23 00	
Carpenters, 200 hours, at 17½ cents per hour	35 00	
Laborers, 224 hours, at 15 cents per hour	33 60	
Water boy, 59 hours, at 8 cents per hour	4 72	
		185 07
Foun dation mattress:		
Constructing foreman, 2 days, at $75 per month	5 00	
Laborers, 575 hours, at 15 cents per hour	86 25	
Sinking foreman, ½ day, at $75 per month	1 25	
Laborers, 127 hours, at 15 cents per hour	19 05	
		111 52
Filling between rows:		
Foreman, 10½ days, at $75 per month	26 25	
Carpenters, 20 hours, at 25 cents per hour	5 00	
Boatman, 15 hours, at 20 cents per hour	3 00	
Carpenters, 90 hours, at 17½ cents per hour	15 75	
Laborers, 2,369 hours, at 15 cents per hour	355 35	
		405 35

DIKE NO. 2.

Stretching cables:		
Fireman, 10 hours, at 20 cents per hour	2 00	
Carpenters, 60 hours, at 17½ cents per hour	10 50	
Laborers, 20 hours, at 15 cents per hour	3 00	
		15 50
Removing drift:		
Boatman, 10 hours, at 20 cents per hour	2 00	
Laborers, 258 hours, at 15 cents per hour	38 70	
		40 70
Driving piles:		
Foreman, 3 days, at $90 per month	9 00	
Carpenters, 80 hours, at 25 cents per hour	20 00	
Carpenters, 360 hours, at 17½ cents per hour	63 00	
Laborers, 60 hours, at 15 cents per hour	9 00	
Water boy, 60 hours, at 8 cents per hour	4 80	
		105 80

Bracing:		
Foreman, 4½ days, at $90 per month	$13 50	
Carpenters, 125 hours, at 25 cents per hour	31 25	
Carpenters, 30 hours, at 20 cents per hour	6 00	
Carpenters, 552 hours, at 17½ cents per hour	96 60	
Laborers, 92 hours, at 15 cents per hour	13 80	
Water boy, 78 hours, at 8 cents per hour	6 24	
		$167 39
Foundation mattress:		
Constructing foreman, 1 day, at $75 per month	2 50	
Laborers, 348 hours, at 15 cents per hour	52 20	
Sinking foreman, ½ day, at $75 per month	1 25	
Laborers, 100 hours, at 15 cents per hour	15 00	
		70 95
Sinking old barge:		
Foreman, ½ day, at $75 per month	1 25	
Laborers, 49 hours, at 15 cents per hour	7 35	
		8 60
Filling between rows:		
Foreman, 7 days, at $90 per month	21 00	
Foreman, 21 days, at $75 per month	52 50	
Carpenters, 32 hours, at 25 cents per hour	8 00	
Carpenters, 20 hours, at 22½ cents per hour	4 50	
Carpenters, 310 hours, at 17½ cents per hour	54 25	
Laborers, 5,900 hours, at 15 cents per hour	885 00	
		1,025 25
Total		6,169 55

The accompanying sketch shows the location of the dikes and the changes effected thereby. The shore and channel lines in red are those of 1881.

Very respectfully, your obedient servant,

E. F. OFFICER,
Assistant Engineer.

Capt. H. S. TABER,
Corps of Engineers, U. S. A.

B.—REPORT OF CAPTAIN H. S. TABER, CORPS OF ENGINEERS, IN ANSWER TO SENATE RESOLUTION OF FEBRUARY 25, 1885.

UNITED STATES ENGINEER OFFICE,
Little Rock, Ark., March 11, 1885.

GENERAL: In accordance with the requirements contained in an indorsement, Office Chief of Engineers, United States Army, February 26, 1885, upon the resolution of the Senate of the United States, date of February 25, 1885, I have the honor to submit the following report as to "What is advisable and necessary to prevent the obstruction of navigation through the draw of the railroad bridge at Rob Roy, in the Arkansas River, Arkansas, to remove the sand-bars to prevent the future formation of sand-bars in said river between the Rob Roy Railroad Bridge and Bell's Ferry, and to insure stability to the Government works in that reach of river, and to the channel section of that river."

Before proceeding to the subject-matter it is pertinent, as showing the elements to be dealt with, to state that the conditions at the Rob Roy Bridge to-day as compared to what they were February 9, 1885, are such that to one not familiar with the changes to which alluvial streams are subject, they would seem not to belong to the same river. On February 9, 1885, at an inspection of the bridge, as called for by act of Congress approved July 5, 1884, the river was caving the banks at the north abutment of the bridge, causing me to decide to make a trip via river to see what could be done to prevent the river leaving the

draw and cutting the banks. Anticipating that the works at Pine Bluff, which had so radically changed the conditions there, would, by changing the points at which the river changed directions, eventually change matters here, I waited a reasonable time, and then, on February 17, 1885, I passed down the river to find, as I had anticipated, the water had left cutting the banks, and was now making for the middle of the bridge, and to-day I am informed by reliable authority that the channel has not only changed from the north to the south side of the draw, but actually threatens to seek the middle of the river, throwing a bar against the former caving bank, and into the draw, and, actually, we find not only the bar that I reported February 19 as forming down entirely removed, but another thrown in from the other side and threatening to do the same thing from a directly opposite point. In other words, if the works at Pine Bluff had been a third less effectual they would have been just the thing for the Rob Roy Bridge. On February 17 it appeared to me that everything was going to come out right, but it was a little too much. It will be borne in mind that nothing concerning Rob Roy Bridge entered into the Pine Bluff problem, but so quickly do these streams answer to treatment that the works at Pine Bluff became the salvation of the abutment of a bridge 6 or 7 miles away. If the problem given was simply to prevent the channel leaving the draw, all that would be necessary would be to go to some bar above that was forming down-stream, and which consequently the river will take care of, and put thereon a small deflecting dike to cause the river to slightly change its direction at this point, and thus swing in on the right curve at the bridge.

The works at Pine Bluff have demonstrated that this is sure if the dike is only placed on a bar that is *forming down.*

The river goes on adding to its own work and making the dike stronger, while the dike sets the river to work upon a different series of curves, which eventually take in the point in question, and give thus a change which, if attempted to be brought out in the face of the river, at the point will be looked for in vain, and that, too, after enormous outlay, as compared with the simple, common sense, effective way just noted. But the problem calls for a regulation of the channel from Bell's Ferry to the bridge. If what has gone before has been properly understood, it will be seen that, where so slight causes produce such radical changes, the works called for in the resolution will have to be watched and gone over again every few years, inasmuch as when anything for miles above Bell's Ferry changes the curves of the river, the change will move along down and take the works from a new quarter; and unless prompt action is taken above to change it back, the works in the places the river once cared for will be attacked now, and if not entirely removed will lose their effectiveness. This view of the case prepares the way for the statement that no permanent improvement of the channel in any given place on a long alluvial stream can be effected while the rest of the river is left to pursue its own free will. But it does not follow from this that it cannot be improved in a semi-permanent way, which, if watched, can be made practically permanent. It is to this semi-permanent improvement, guarded as I have indicated, that plans have been carried out so far in the reach in question, and it is believed that by carrying out the same general plan, using a little money and making the river do its own work, it can eventually be unwound, so to speak, when the formation of bars will cease, and the straightened river will bear down in a long line upon the bridge and then take care of itself. * * *

As I understand the problem, the town of Pine Bluff with its present protected front is to be considered. Before proceeding further I will state that, to solve this problem, ignoring Pine Bluff, all that is necessary is to make an artificial cut-off at Yell's Bend, and straighten the river a little above by one or two dikes. As this, however, is not presumed to be an admissible solution, I proceed to indicate how, at comparatively little expense yearly, the river can be held within certain limits, always bearing in mind that the grand total of this method will be largely in excess of the cut-off solution, which I consider the only correct solution of the problem of navigation, pure and simple. Much of the following plan is rendered more feasible by the fact that the plant requisite to carry it out is now on hand at Pine Bluff, Ark., and is in excellent trim for work. The plan is as follows:

Let the Rob Roy Bridge be taken as the first point of observation, and the dikes as the second, and the channel as the third. Let the engineer in charge have from $5,000 to $7,000 a year at his disposal. Then when he sees that there is a tendency on the part of the river to interfere with any one of the three matters to be observed, let a small dike, like those now in the river, be thrown on a bar that is *forming down*, and so located as to correct this tendency.

This may seem very simple, and yet it can be made more effective than works representing millions put in to wall the river, and which the river will surely wash out eventually, unless walled its entire length. To make this clear, the river goes in curves to-day, as indicated in the heavy line.

* * * * * * *

Next week it is moving toward the dotted line under the dike's work at A. Suppose the dark portion were walled, and a few miles above A some cut-off changes the channel and the river strikes, we will say, C, on an entirely new curve, and gets back of the works. Supposing C was the head of the walled portion, of course the revetments, &c., are taken at a disadvantage, and all are taken eventually.

* * * * * * *

A small dike dropped in now and then by a judicious engineer will correct any bad tendency of the river at such a trifling cost that, if in six years it is no longer of any use, it has paid for itself, and its loss is immaterial.

To illustrate how a dike on a bar forming down-stream does its work, refer to Plate I and Dike No. 1, which was thus located. The river continued to pile a sand-bar up and over it as a matter of course, and had no disposition to cut it out, because it was filling its site anyway. But the dike being left to its own work, poured a solid current of water 12 feet deep, and straight across against the bar and bank at X on A or B, and cut that bank back over 175 feet, measured in a line at right angles to the other channel, and produced other changes below already specified. Now, it is clear if one dike can change a channel over 600 feet, as was done here, that when we only desire to change it a few feet there can be little question of being able to do so.

It may be asked why no attempt is made to point out the location of a few such dikes. To this, answer must be made that this is a matter that can only be done on an alluvial stream for each particular case, by considering the actual conduct of the river at the time, and calls for experience and judgment in each particular instance. To illustrate, suppose the engineer in charge sees, as he watches the fluctuation of the channel above "Yell's Bend" that the river is likely to take some of the Government works to disadvantage. He proceeds at once with

the allowance in hand to such a bar above "Yell's Bend" as he learns (easy enough from river men) is *forming down*, one or two trips in a skiff enables an experienced man to calculate where the new curves will strike, and where the dike to make these curves shall be put. At a trifling expense he throws up the dike, the river changes its curves, and the works are protected. The same applies to the channel at the Rob Roy bridge. It may be asked if plans could not be prepared so as to keep the channel about what it is? To which answer may be made, yes, providing the United States Government will enter into river and harbor improvements as the French have done, and are prepared to expend millions upon this river above the reach in question. It is believed that such a plan, which would delay this report for some time, would be so Utopian as to not even warrant the time spent upon it, while the plan here proposed will answer the same purpose, is sure in its effects, simple in detail, and as a matter of dollars and cents is insignificant in cost compared with the other. Therefore no time will be taken to prepare the elaborate, expensive plan, unless it is expressly desired. It may be well to add, that if it were possible to go over this reach of river with a number of gentlemen interested in the matter, the effectiveness and economy of this plan could be more clearly shown in a few hours than it ever can be on paper, as it is *eminently practical*, as over against *theory*. The testimony of a grateful people, in the recently imperiled town of Pine Bluff in this very reach, is of itself sufficient evidence of its effectiveness and feasibility. In this case the simplicity of the plan drew down a torrent of abuse, and adverse criticism, but when the wonderful (to them) results came along it was a different matter. Property has advanced 50 per cent. along the town front, and the simple works are daily visited by the curious, who regard them with as much wonder now as they did with scorn a few weeks since. From what has preceded, it is recommended that from $5,000 to $8,000 be appropriated yearly, to be carried forward if not needed, and that this amount be expended, as indicated herein, in watching the river. If in any year this amount be not required, so much of it as is not required shall be reported in time, so that this amount may be deducted from the next regular appropriation. I have not seen this particular reach of the river long enough to say definitely, but it is my opinion that the amount is not likely to be required oftener than once in three years on an average; but for the sake of continuity of work, that the engineers may be always able to act promptly in the matter, the appropriation should be made as indicated. The time that has elapsed since that letter was written (recommending a certain sum of $20,000 for this same reach) having given me more time for observing the effects at Pine Bluff, and to study the river, leads me to consider the small yearly appropriation here recommended a better plan than the one calling for $20,000. This, however, is wholly a question of economy, not of practical engineering, as that is the same in both cases. So far as the interests of the Government work and navigation are concerned, the sum specified has been reserved for this very purpose this year, as will be seen by referring to my report of operations for the month of February, 1885, and operations contemplated in March, out of the appropriation made last year, this being in accord with certain projects approved in your office.

I am, general, very respectfully, your obedient servant,

H. S. TABER,
Captain of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

C.—REPORT OF MR. S. P. ADAMS, ASSISTANT ENGINEER.

MAY 23, 1885.

CAPTAIN: I have the honor to submit the following report of operations at Pine Bluff, Ark., during the part of the fiscal year ending June 30, 1885, that the works there were in my charge.

The following is the cost of the plant constructed:

Constructing one pile-driver barge, 70 feet long by 20 feet wide and 4 feet deep, with four solid gunwales:		
Cost of labor		$235 56
Cost of lumber		108 58
Cost of iron, oakum, nails, &c		31 14
Total cost of barge		375 28
Cost of cabin built over engine and boiler	$25 79	
Cost of pile-driver leads framed and put up ready for work	27 50	
		53 29
Total cost of pile-driver and barge, with machinery		428 57
Cost of one shed for blacksmith-shop		15 00
One shed for box factory		25 00
Repair of four old barges		27 00
Construction of one mattress-barge, 150 feet long, 28 feet wide, and 5 feet depth of gunwale, with ways ready for work, as follows:		
Lumber		380 00
Labor		1,074 19
Iron, oakum, nails, &c		139 20
Total		1,593 39

The above includes all labor put on the barge and a portion of the expense or grading a place to build barges, also the salary of the time-keeper, receiver of material, and foreman during the period the barge was under construction.

Construction of two stone barges, 65 feet long by 18 feet wide and 2½ feet depth of gunwale, and two barges 65 feet long, 18 feet wide, and — feet depth of gunwale:	
Cost of lumber used	$397 60
Cost of nails, oakum, iron, &c	77 23
Cost of labor	1,399 12
Total cost of four barges, an average cost per barge of $468.49	1,873 95
Two small flat-boats, to run with oars, were constructed of scrap lumber and culls, at $10 each	20 00
Six boat-pumps were made, at $2.50 each	15 00
One water-gauge was made and erected, at $8	8 00
One small derrick-barge and small derrick was constructed of scrap lumber and culls, at a cost of	95 00
Five skiffs were built, two of them 26 feet long and three of them 24 feet long, at a cost as follows:	
Material	25 80
Labor	88 11
Total	113 91

Average cost per skiff, $22.78.

This does not include cost of lines, tools, machinery, pile-driver, hammer, &c., or any articles purchased through the office at Little Rock, nor the repairs on any of the plant during the progress of the work.

Parties owning land close to the works kindly gave permission to get pine and oak brush off their land free of charge; 4,913 cords of this brush were cut and hauled to the bank of the river at the works, while the roads were good, and stacked up, at a cost of $3,201.96 for 4,368 cords of it, or 73 cents per cord, and $563.69 for 545 cords, or $1.034 + per cord. As a large body of willow was found growing on public land, being in a dry lake bed 4½ miles from the work, I was enabled to secure 2,276 cords of this brush ready for use, at a cost merely of the labor in cutting, hauling, and stacking it up, which amounted to $1.566 + per cord, or $3,564.67 for the entire 2,276 cords. Verbal contracts were entered into with different parties to furnish 1½-inch pine and oak plank, delivered at the works at $9 and $9.50 per M feet B. M., and 25,900

pounds of nails were purchased, at $2.55 per 100 pounds, delivered for the purpose of making boxes to be filled with sand, and used in lieu of stone for weighting the brush and mattresses, as it was found that stone would be more expensive than such sand-boxes, having to be shipped from a distance. There were two sizes of the boxes manufactured, the smaller ones being 18 by 24 by 15 inches, exterior dimensions, and the larger ones 36 by 24 by 18 inches, exterior dimensions. The average cost per box of the smaller ones, with tops nailed on (not including the cost of filling with sand), was 30 cents, and the average cost of the larger ones per box was 49 cents.

Although the large boxes cost less than the small ones in proportion to the weight of sand they held, it was found more advantageous and cheaper to use the small boxes, especially in sinking mattresses, owing to the large ones being so heavy and troublesome to handle when filled with sand, and bursting open too readily from a fall or rough handling.

The sand-boxes proved cheaper than stone, and could be handled more advantageously, besides keeping in position on the mattress better, as they were flat and they did not sift through the mattress as small stones are apt to do.

Twenty thousand four hundred and forty boxes were manufactured, at a cost as follows:

Lumber	$4,756 86
Nails	538 13
Labor	2,304 21
Total cost	7,599 20

Enough lumber for manufacturing 1,866 boxes was sawed into proper lengths, and stacked up so as not to check or otherwise injure, at a cost as follows:

Lumber	$314 80
Labor	121 29
Total cost	436 09

Bids were invited from different parties for furnishing piles, waling pieces and braces, delivered on the river-bank, above high water, at the works. A verbal contract was entered into with Culwell Brewer, the lowest bidder, to furnish them, of required length, at 5 cents per linear foot.

Dike No. 1 was commenced on the right or south bank of the river about 1,000 feet above Brump's Bayou, and was extended out on a line considerably inclined down-stream, so as to make quite an acute angle with the shore, a distance of 1,364 feet, and built to a height of 12 feet above extreme low water. The first 400 feet next to shore was constructed of alternate layers of heavy brush mattresses and boxes of sand, and when completed the structure was 120 feet wide at the base and 30 feet wide on top. The balance of the dike (968 feet) consisted of two rows of piles 12 feet between the rows and 8 feet apart in the rows, with waling-pieces extending along both rows of piles at a level 12 feet above extreme low water. Cross-ties were placed at every pile and securely fastened to them with three-quarter-inch screw and washer bolts. Both rows of piles for 500 feet were wattled with long heavy willow brush, from the river-bed up to the waling, and the space between the rows of piles was filled up to the cross-ties with alternate layers of brush and sand-boxes. The security of the work was further provided for by having it rest on a foot-mat 120 feet wide and 1,472 feet long, heavily weighted with sand-boxes, through which the piles were driven. The up-stream edge of this foot-mat was placed 70 feet from the axis of the dike, and the down-stream edge 50 feet from it, and its outer end extended 108 feet beyond the outer end of the dike. The 1,364 feet of dike were completed under my charge with the exception of 224 feet of the outer end, which required cross-ties and 8 feet additional filling of brush and sand-boxes, 13 feet in depth having been filled and weighted when I turned over the work to my successor. A rise in the river carried away 70 piles at the outer end of the dike, which had not been secured with waling-pieces or cross-ties, and of course had not received a filling of brush and sand-boxes. These were replaced.

The following is an itemized statement of the cost of Dike No. 1:

Cost of 400 feet of brush and sand-box dike, transporting 1,957 cords of brush from bank to dike, and weaving mattress	$2,297 12
Filling 755 boxes with sand and transporting them to dike and placing them	929 5
1,957 cords of brush used	1,621 66
7,551 boxes used	3,530
Total cost of 400 linear feet of sand-box and brush dike	8,379 19

Cost of foot-mat 120 by 1,472 feet, sunk and weighted; transporting 1,376 cords of brush from bank to mat, and weaving mat	$2,193 17
Filling 3,297 boxes with sand, transporting them to mat, and weighting and sinking it	529 62
1,376 cords of brush used	1,531 17
3,297 boxes used	1,153 86
Total cost of foot-mat	5,407 82
Cost of 964 feet of pile, brush, and sand-box dike; driving 11,545 linear feet of piles, at $0.0965+ per linear foot	1,114 60
Putting on 5,276 linear feet of waling and cross-ties, at $0.166+ per linear foot	879 62
Transporting piles, waling-pieces, and cross-ties to dike	93 00
Transporting 1,209 cords of brush from bank and placing it in dike	531 80
Transporting 50 cords of willow from bank and watling 500 feet of dike	44 00
Filling 2,703 boxes with sand and transporting them to dike and placing them	372 67
11,545 linear feet of piles, at 5 cents per linear foot	577 25
5,276 linear feet waling-pieces and cross-ties, at 5 cents per linear foot	263 80
1,676 pounds of screw and washer bolts, at 4 cents per pound	67 04
1,259 cords of brush used	774 28
2,703 boxes used	824 04
Total cost of 964 feet of pile, brush, and sand-box dike	5,542 10
Total cost of Dike No. 1	19,329 11

This dike withstood the high water in the river quite well, and caused a large deposit of silt on the lower side of it, extending down-stream some distance, and a small deposit above and at its shore-end, being buried in sand up to the waling-pieces for a distance of 800 feet from shore. During one rise in the river it deflected the current to the opposite bank, and caused considerable erosion there for a distance of 1 mile. Just opposite the dike the scour was sufficient to carry away the entire sand-bar which extended one-third the way across the river, making a navigable channel at ordinary low water, 150 feet inshore from where the crest of the bank was before the rise. The strong current that swept along the town front during high water had apparently changed to the middle of the river too.

Caney Bayou crossed the dike just where it joined shore and undermined it to that extent that it was found necessary to change its course so that it would empty into the river above the dike at extreme low water. This was successfully accomplished, at a cost as follows:

Labor building dam 125 feet long, 12 feet wide, and 5 feet high across the old channel	$70 85
Labor excavating new channel	224 67
Eighteen boxes used	5 40
Total cost	300 92

A bank-protection mattress was commenced for the protection of the town front at the foot of Severe street, and when only 150 feet of the mattress had been constructed it was determined to sink it, as a rise in the river was expected, but before this could be accomplished the high water was upon us, bringing great quantities of drift, which collected under the mattress and at its head to such an extent that it was found impossible to sink it then, and nothing more could be done than secure it as far as possible with extra lines and ward off drift until the rise was over. But a second rise coming soon after the first brought so much drift that the lines parted and the mattress went out, taking a stone barge with it. I landed the barge 3 miles below, and it was towed back by the United States snag-boat Wichita.

The cost of the mattress was as follows:

Labor	$150 00
75 cords of brush used	92 00
Total cost	242 00

A second dike (No. 2), 157 feet long, was constructed a quarter of a mile below Brump's Bayou, extending out from the south or right bank of the river, and at about the same angle with the current of the river as the other dike. In its construction piles were driven in rows 20 feet apart at the shore end, and widening as the work advanced into deeper water, being 30 feet apart at the outer end, which rested in water 35 feet deep at extreme low stage, and the piles were 8 feet apart in the rows. A foot,

mat 120 by 260 feet was sunk on the line of the dike, and heavily weighted with sand-boxes, and another mat 120 by 167 feet was sunk on top of this one, extending from the shore and heavily weighted, thus forming a double mat 167 feet of the distance, and a single mat for the rest of the length, 93 feet. The two rows of piles were driven through the mat, so that the up-stream edge of the mat was 70 feet from the axis of the dike and the down-stream edge 50 feet from it. Heavy waling-pieces were put on the entire length of each row of piles, 1½ feet from their tops and 12 feet above extreme low water, and were firmly bolted to each pile with three-quarter-inch screw and washer bolts, and heavy cross-ties were fastened on in the same manner to each couple of piles; 56 linear feet of the structure was filled with alternate layers of brush and sand-boxes to the level of the waling-pieces, and the balance of the dike was filled one-half that height. On account of the dike being situated in deep water, where the current impinges against the bank with unusual force, and where the drift all flows during high water, it was thought advisable to further strengthen this structure. For this purpose one end of a three-quarter-inch wire cable was attached to the dike, 50 feet from the shore, and the other end secured firmly to two mooring piles driven 30 feet into the ground on shore, 100 feet above the shore-end of the dike, and three rows of piles to brace the dike were driven 25 feet apart at right angles to it, which extended to shore on the down-stream side. The piles were 16 feet apart in the rows, and strong waling-pieces were bolted to them, which extending from shore through the main dike to the upper row of piles and were there firmly bolted to the piles of the dike.

The following is an itemized statement of the cost of Dike No. 2:

Cost of foot-mat 120 by 167 feet and one 120 by 260 feet, sunk and weighted:		
Transporting 392 cords of brush from bank and weaving mats		$944 00
Filling 2,400 boxes with sand, transporting them to dike, and sinking and weighting mats		451 85
392 cords of brush used		548 47
2,480 boxes used		752 34
Total cost of mats		2,696 66
Cost of 157 linear feet of pile, brush, and sand-box dike:		
Driving 3,859 linear feet of piles, at $0.1514 per linear foot	$584 17	
Putting on 2,174 linear feet of waling and braces, at $0.1116 per linear foot	242 72	
Transporting piles, waling-pieces, and cross-ties to dike	55 75	
Filling 540 boxes with sand, transporting them to dike, and placing them between the rows of piles	81 00	
Transporting 331 cords of brush to dike and placing between the rows of piles	132 60	
3,859 linear feet of piles, at 5 cents per linear foot	192 95	
2,174 linear feet walings and cross-ties, at 5 cents per linear foot	108 70	
540 boxes used	162 79	
331 cords of brush used	225 24	
976 pounds of screw and washer bolts, at 4 cents per pound	39 04	
Total cost of pile, brush, and sand-box portion of dike		1,824 93
Total cost of Dike No. 2		4,521 59

Although this dike had only been carried out 157 feet when I left, its effect on the opposite bank was already apparent, as the bar, which presented a bank with a very gentle slope before this dike was built, assumed the appearance of eroding rapidly, even at the ordinary stage of river that then obtained.

Very respectfully, your obedient servant,

S. P. ADAMS,
Former Assistant in Charge.

Capt. H. S. TABER,
Corps of Engineers.

V 5.

IMPROVEMENT OF BLACK RIVER, ARKANSAS AND MISSOURI.

Before any improvements were made upon this river, its channel was choked with logs and snags, and obstructed by overhanging trees, and in many places shoals interfered with its navigation at low water by any but very light-draught boats. Its banks caved but little, and, except at the shoals, it was characterized by greater depth of water than is found in streams generally in its vicinity, due to its being nar-

row and its banks firm. The original plan for its improvement which has been rigidly adhered to, contemplated the removal of the obstructions and the improvement of the shoals, the latter by wing-dams. A few sloughs were to be closed up, so as to confine the water to the main channel. Up to June 30, 1884, $29,946.08 had been expended, as indicated above. This expenditure had given great relief to navigation at certain points but the work lacked continuity, and owing to there being no plant suited to the work, my predecessors expressed themselves as unable to accomplish results desired or reasonably expected, though thorough work was done at each point when it was undertaken. On July 3, 1884, my predecessor, Maj. M. B. Adams, transferred to me $1,053.92. By act approved July 5, 1884, $20,000 was made available for this river; $15,000 to be used in building a light-draught snag-boat. It appearing from the reports of my predecessors that a snag-boat was the first essential to effective work, attention was given at once to its construction. After duly considering the matter it became apparent that it would be most economical and advantageous to the Government to build this boat by hired labor and the purchase of material in open market.

The plans of a boat of commerce, recently built here, costing $25,000, were carefully gone over, and after noting certain matters indicative of poor economy, &c., it was decided to lay out the new boat as fully her equal, and then by judicious economy build her for the amount allotted. All expenditures were most carefully watched, and the material used was under my personal supervision daily. The defects of the older snag-boats were noted, and two experienced snag-boat captains, W. J. Ashford and H. A. Mayer, were called upon to name any improvements their experience might suggest. The hull was stayed for the peculiar strains to which it would be subjected. Greater space was given on the bow for handling the snags after they are raised. The machinery was required to be plain, all money being put into strength and capacity. Much time being lost in letting go of a snag to take hold at the proper point again, it was decided to provide this boat with double sets of grappling appliances and with two independent steam capstans. Furthermore, as ordinarily a light rapid-working capstan will handle the majority of snags met with, one of these capstans was of this nature, a Providence steam capstan, capable of lifting 75 tons and running rapidly, while the other is a powerful capstan with reversible engines, and capable of lifting any snag that the width of the boat's bow will allow it to raise, running, of course, with a very slow motion. The boat which was christened the Henry Sheldon, with crew and provisions on board, draws a little less than 15 inches of water. She is 135 feet long and 26 feet beam, and was pronounced by competent judges to be the most thoroughly-built boat that ever left the ways here. She was placed in charge of a foreman, who now commands her, a man of large experience with steamboats and in steamboat building, Capt. H. Hennegin, and it is but justice to say that to his faithful attention, excellent skill, and judgment the public service is much indebted, and his efficient handling of the boat since taking the field, with his strict fidelity in the discharge of every trust, have rendered him well nigh invaluable to the interests of this district. The *Henry Sheldon* left for her field of operations after one or two trial trips, upon which she carried supplies to the survey party on the lower Arkansas River, January 12, 1885, and began snagging operations February 7, 1885, with orders to open a channel right through to head of navigation if possible, and then work back widening her work. During February and March

she pulled 120 snags, cut 9,291 trees, removed one drift pile, and deadened 3,607 trees and left the river for miles from its mouth in excellent condition at medium stage of water. Her running expenses are the best proof of her adaptability to her work, being notedly less than either of the other snag boats for the same work. Thus far she appears capable of as much work as the iron hulled boat, the C. B. Reese. She can be kept constantly employed when the water is at the proper stage in the Black, White, and other rivers tributary to them, and her advent in this section of the district will prove of inestimable value in the judicious economical expenditure of moneys appropriated or that may be appropriated for it.

A feat performed by this boat upon the White River, in connection with its survey, will be noted in its proper place. During the months of March, April, May, and June, the stage of water was such that the snags interfering with low-water navigation could not be reached. It was therefore deemed best to lay the boat up in ordinary until such time as the balance available could be used to best advantage. She will probably be used the coming season under proper authority upon the White River, as her own appropriation is practically exhausted. Snagging operations in this stream, as in others of similar character in this district, have to be repeated annually, though not so much so in this particular river as in some others, on account of the more permanent character of its banks. There are a few shoals that should be improved by wing dams, and possibly a few chutes that need closing. Taking all these facts together it is estimated that $10,000 could be profitably expended during the fiscal year ending June 30, 1887. In my report, under General Orders No. 13, Office of Chief of Engineers, series of 1884, it is intimated that no improvements are called for above the mouth of Current River. I was led to make that statement by certain remarks made by my predecessors, to the effect that railroads had so changed the condition as to practically render the improvement unnecessary. As there is a wide difference of opinion as to the policy to pursue in matters of transportation, I prefer to withdraw all then said, and to state that the river is susceptible of improvement and worthy of the same as high as Poplar Bluff, Mo., and from such data as I have been able to secure, the interest of the common people in the matter of cheap transportation calls for such improvement. It is not for the engineer to enter into the merits of river *vs.* rail transportation; but it may be pertinent to add, that with a river choked with snags and logs, and a railroad completed and operated, the only fair test of the demand for river transportation would seem to be the opening of the river and placing it for the nonce on a par with its rival, the railroad. It is believed that after this river is thoroughly opened up, a sum not to exceed $8,000 per year will keep it open to navigation, until the country becomes cleared up, when a less sum would suffice on account of the smaller number of snags likely to be brought in annually.

COMMERCE.

I have been unable to obtain reliable data as to the amount of commerce on this river. Large quantities of staves are taken out of the country bordering on the upper portion and shipped by rail at Poplar Bluff. The amount of cotton and other produce that is taken from the lower portion of the river is constantly on the increase.

Money statement.

July 1, 1884, amount available		$1,053 92
Amount appropriated by act approved July 5, 1884		20,000 00
		21,053 92
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$19,438 82	
July 1, 1885, outstanding liabilities	225 90	
		19,664 72
July 1, 1885, amount available		1,389 20
Amount that can be profitably expended in fiscal year ending June 30, 1887 Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		10,000 00

EXPENSE ACCOUNT.

Constructing snag-boat Henry Sheldon:	
Pay-roll for labor, &c	$4,346 51
General supplies	1,590 96
Lumber	2,388 11
Hardware	593 55
Machinery	4,186 18
Furniture	820 73
Freight on machinery	238 41
Paints	363 32
Safe	60 00
Stationery	50 10
Telegraph service	3 15
Skiffs	50 00
Office rent	30 00
Total	14,721 02
Improving river:	
Pay-rolls for labor, &c	3,277 84
Subsistence stores	804 45
General supplies	239 59
Fuel	295 66
Stationery	20 45
Machinery	35 70
Traveling expenses	32 80
Lumber	10 55
Telegraph service	76
Total	4,717 80
Grand total	19,438 82

V 6.

IMPROVEMENT OF WHITE RIVER, ARKANSAS.

This appropriation was made by act approved July 5, 1884, and is the first separate appropriation made for the entire river, if the small one of $10,000, made by act approved March 3, 1879, is excepted. Earliest appropriation made for this river, under any head, was made by act approved March 2, 1833. Summing up all the various works of improvement, it may be inferred that, prior to 1833, this river was much choked with drift-piles, logs, and snags in its lower portion; and, say, from Batesville up, gravel bars, rocky shoals, channel bowlders, and overhanging

trees impeded navigation. In the originally adopted project snagging operations figured largely; to these were added blasting operations for ledges and bowlders, and dam-building to remove gravel bars or to close chutes, from time to time, as appropriations warranted and commerce required. This river has been united so often with the Saint Francis, and again once with the Black and Saint Francis, and once with the Black and Little Red, that having no records in this office earlier than the first Annual Report of the Chief of Engineers, received after the entry of the officer in charge into the service in 1873, it is impossible to give exactly how much had been expended on the White River to June 30, 1884. After a careful study of House Ex. Doc., No. 64, Forty-eighth Congress, first session, the approximate amount is set down as not under $170,000 and not over $200,000. This estimate should be given a weight, 8 in a scale of 10. On July 1, 1884, the river was in excellent navigable condition for boats drawing not to exceed 3 feet of water from its mouth to Newport, Ark. From Newport to Batesville there were many troublesome snags, and from Batesville to Buffalo Shoals there were numerous bad shoals, rendering navigation very uncertain. From Buffalo Shoals to Forsythe, Mo., there were many fine reaches of river; but the depth of water on Buffalo Shoals and others less dangerous prevented any navigation at ordinary stages of water. The first project proper, under this separate head, was forwarded to your office August 18, 1884, and received back approved August 25, 1884, and, briefly stated, provides that the $35,000 appropriated be "employed in the general work of improving the White River, removing snags and bowlders and other obstructions to navigation; building wing-dams to improve shoals, repairs to plant and care of same," and "to survey the river, as provided for by my predecessor, accurately, with a view to its improvement from Forsythe, Mo., to as far down as possible, at an expense not to exceed $80 per mile," a fixed sum of $11,366 to be set aside for the survey. The survey was begun early in May, 1885, and was in progress at the close of the present fiscal year. Except when the interests of navigation required immediate improvements, it was deemed best to do as little work as possible until the survey gave a better idea of where the money could be applied to best advantage. Survey will be completed early in next fiscal year, when work will be resumed. To accomplish the work referred to above $8,407.37 has been expended during the year ending June 30, 1885. The principal expenditures for improvements made during the fiscal year ending June 30, 1885, were made for that portion of the river lying between Jacksonport and Buffalo Shoals. As will be seen elsewhere, there was an unexpended balance of the appropriation for the "improvement of the White River between Jacksonport and Buffalo Shoals," available July 1, 1884. When this was exhausted work was continued for a short time under this head. The following is entered here, taken from the report upon improvement of White River between Jacksonport and Buffalo Shoals.

"Active operations were begun July 7, 1884, and continued until this balance was entirely exhausted, after which they were carried on under the general head of appropriation, 'Improving White River, Arkansas.' Finding that a light-draught, low-power, steam-propelled snag-boat could be advantageously used, both for snagging and the other purposes set forth in the original plan, authority was obtained to fit up the small steamer Picayune, that was lying idle at Pine Bluff, for this purpose. With little delay this boat was fitted for the field, and during the entire season worked so economically and effectually as to afford great relief to navigation, and to win high encomiums from the parties navi-

gating the river. Snagging, cutting trees, and removing bowlders seemed to be of first importance to pave the way to improving the shoals, and the operations were confined to this work. This outfit did, in proportion to its cost, the best work of any outfit in the district, due to the economy practiced by Mr. E. F. Officer, assistant engineer in charge, whose report will be found appended and marked A. This boat carried a powerful Worthington pump and hose for grading, as practiced at Pine Bluff in 1881–'82. This pump was found to be of great assistance in working the boat over gravel shoals, and enabling her to get at her work proper. In several instances absolutely impassable shoals were passed over in a very short time by the judicious use of this pump and its appliances."

In order to take advantage of a trained force, the survey was postponed until the spring of 1885. The survey of the Lower Arkansas River having been completed early in April, the entire party on board the quarter-boat was towed from the mouth of the Arkansas River to Newport, on the White River, and an examination of engineers, rodmen, &c., held, prior to the discharge of the party. This provided a means of securing the best men of this survey for the new one, which would carry a reduced force. Having ascertained by a reconnaissance that the quarter-boat used on the Lower Arkansas could only be used from Buffalo Shoals down, a foreman was dispatched in March to Forsyth, Mo., to build a lighter-draught quarter-boat, to be completed April 25, 1885. My plan was to take advantage of the spring rise in the river and, if possible, send the new light-draft snag-boat Henry Sheldon through to Forsyth, with the entire outfit required for the new boat.

The assistant engineer who was to have charge of the survey was engaged as custodian of the property and a few trusty men retained, and the balance of the party discharged. The snag-boat at once started, with the old quarter-boat in tow, reached the worst shoals without delay, but found only 10 inches of water, she drawing 15 inches. In twenty-four hours the river rose 10 feet. The boat left the quarter-boat here, ran 125 miles and back on the rise, unloaded her outfit upon the new quarter boat, and returned safely over the shoals before the water fell. Special praise is due to Captain Hennegin for this feat, as his boat, the Henry Sheldon, being 135 feet long, was a very large boat to handle upon this reach of river. This resulted in an enormous saving of expense in the way of transportation, as Forsyth is 25 miles from the nearest railway station. Subsistence being secured, the party was put into the field and work begun May 11, 1885. From April 28 to May 11 the party sent with the outfit attended to all the minor details, so that by the time the large force arrived they were ready to commence work, avoiding keeping an expensive force at work upon preliminary work. Satisfactory progress has been made upon this survey up to the close of the present fiscal year.

From all that I can learn it will be a survey in keeping with the high standard of excellence usually accorded to surveys made under the Engineer Department. Every precaution has been taken to make it such. As in the case of the Lower Arkansas River, each assistant engineer's notes will be submitted to this office for approval before his accounts are finally settled. The work will be carried just as far down the river as the present funds will allow.

The balance of the $25,000 originally recommended by my predecessor should be made available as soon as possible in order that the present plant be used to complete the survey. As the force now at work is the result of a sifting process which has given to it some of the best civil

engineers in the Southwest, it is a matter of great regret that the entire amount necessary is not available to complete the work with this force. As soon as the survey has advanced far enough, an outfit will be put at work upon the improvement of the worst shoals, so far as the unexpended balance will admit. Many times this balance could have been expended during the last fiscal year, but as the balance on hand was small at best, it was thought advisable to wait until the survey would enable this office to use every cent of it where it would tell to the best advantage. No interests of navigation have suffered by the delay, and when the amount has been finally expended it is expected that lasting benefit will be conferred upon the interests referred to. As in the survey, so in the improvement, it will be possible during the coming season to put the very best of the men of this district into the field, insuring economical, rapid, and successful work. In accordance with authority received from the Office of the Chief of Engineers, the quarter-boat used for the survey of the Lower Arkansas River being more roomy will be used for the survey party from Buffalo Shoals down, and the new quarter-boat will be used for the working parties for the shoals, an economy in plant gained by waiting.

The commerce upon the White River during the past fiscal year is as follows:

Cotton	bales..	21,210
Cotton-seed	sacks..	35,000
Cotton-seed	tons..	510
Merchandise	do...	10,575

This represents the amount actually carried by two steamers during the time specified. There are other small steamers doing a desultory trade that would bring this amount up, but it is found difficult to get reports from them. This trade is principally below Buffalo Shoals. At present there is little or no traffic above Buffalo Shoals. Recent mineral developments in the valley of the Upper White River bid fair to give commerce an impulse hitherto unknown. Just prior to mailing reports the letter appended and marked B was received.

Money statement.

Amount appropriated by act approved July 5, 1884		$35,000 00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$8,407 37	
July 1, 1885, outstanding liabilities	1,786 02	
		10,193 39
July 1, 1885, amount available		24,806 61

EXPENSE ACCOUNT FOR YEAR ENDING JUNE 30, 1885.

Pay-roll, labor, &c	$6,397 67
Subsistence supplies	555 71
Fuel	252 75
Lumber	279 23
General supplies	366 73
Traveling expenses	502 20
Stationery	53 11
Telegraph service	3 12
Express service	1 95
Total	8,412 47

A.—REPORT OF MR. E. F. OFFICER, ASSISTANT ENGINEER.

PINE BLUFF, ARK., *May* 13, 1885.

SIR: I have the honor to submit the following report of operations for improving the White River from Jacksonport to Buffalo Shoals, extending from August 13, 1884, until December 20, 1884; also improving this river below Newport from the date last mentioned until December 29, 1884.

On August 13 I assumed charge of the United States steamer Picayune and barges at Newport, and having selected from the latter two flats and one quarter-boat proceeded to put them in readiness to take up the river. The steamer was supplied with a "B" Providence steam capstan having cylinders 4 inches in diameter and 6-inch stroke, together with shear poles and the necessary rigging to be used for vertical lifts.

Above Jacksonport the river consists of reaches of comparatively gentle water connected by shoals or rapids of steep inclination, and as a consequence of this having swift current. These may be divided into two classes: first, rapids, and second, shoals, both of which render navigation difficult. The "rapids" are those places having excessive inclination, but at the same time with banks near to each other. Here there is always water of sufficient depth, but the difficulty consists in stemming the swift water ascending them.

Between Jacksonport and Buffalo there are only two places of this character, viz, Wolf Bayou and "The Rapids." All the others may be classed with the "shoals," where the inclination of the river is great, the latter being at the same time wide and consequently shallow. In addition to removing obstructions, it was originally intended to improve these places by building wing-dams to concentrate the water.

On going up the river, however, so many snags were found in the channel, that the season was mostly spent in removing them and cutting overhanging trees. The dams built will be described further on, as will also the bowlders removed from the channel. On September 1 the boat was taken up to Black Island, where work was commenced, and from there we proceeded to work up-stream as far as Buffalo Shoals. The results accomplished are tabulated and attached. On returning to Newport orders were received to go below that place and commence snagging. This was done, but on account of high water but few obstructions were met with. Those destroyed will be found tabulated. On reaching Devall's Bluff orders were received to return to Newport for a hoisting engine, and transport the same to Pine Bluff, Ark. This we proceeded to do, arriving at the last-mentioned place on January 15, 1885, where the crew was paid off and the boat transferred to the assistant engineer in charge there.

The table at the lower end of this sheet gives the total expense of the work:

Snags removed between Jacksonport and Buffalo Shoals, total	484
Overhanging trees cut and deadened between Jacksonport and Buffalo Shoals:	
Total cut	1,137
Total deadened	426

In addition to the snags removed and overhanging trees cut, the following work was performed.

Bowlders.—One containing 20 cubic feet was taken from Cackling Pullet Shoal. This was considered very dangerous to boats, as it was sharp and in the center of a swift channel. One was taken from Betsy Gill Shoal, containing 37 cubic feet. Two were taken from Bates Shoal, containing 11¼ cubic feet and 45 cubic feet respectively. Total, four bowlders, containing 113¼ cubic feet.

Solid rock.—At Porter Hodge Shoal two large, sharp, projecting rocks were found, which could only be removed by blasting. For this purpose seven holes were drilled in them, but, not having the necessary explosives, they were not taken out. Two rocks at Buck Island were similarly treated, and all these will be removed when next visited.

Wing-dams.—At Wyatt Shoal we encountered very shallow water, and here it was decided to concentrate it by means of dams built of brush and gravel.

Number 1. An island chute near the south bank was closed accordingly, the work being 50 feet long, 2½ feet high, and 6 feet wide, the volume of material required being 28 cubic yards.

Number 2 was built nearly opposite Number 1, and projects out from the north bank. The average height is 2⅓ feet, width 6 feet, and length 60 feet, and contains 33⅓ cubic yards.

Number 3 was built at O'Neal's Shoal, and connects the lower island with the north bank. It is 4½ feet high, 6 feet wide, and 47 feet long, and contains 47 cubic yards. Total, three dams, containing 108⅓ cubic yards.

Snags removed between Newport and Devall's Bluff, total, 17.

Total expense of work.

Date.	Labor.	Material.	Subsistence.	Total.
August, 1884	$694 44	$95 95	$138 01	$928 40
September, 1884	700 84	94 53	177 80	973 17
October, 1884	810 68	50 93	195 54	1,057 15
November, 1884	691 51	28 33	160 44	880 28
December, 1884	656 85	100 02	142 94	899 81
January, 1885	265 01	40 92	60 00	365 93
Total	3,819 33	410 68	874 73	5,104 74

In the upper portion of the river we were greatly assisted in getting over bars by the use of a large Worthington pump, with which we washed out the channel. This acts on large gravel as well as on sand, but it requires a longer time to effect as much work.

Very respectfully, your obedient servant,

E. F. OFFICER,
Assistant Engineer.

Capt. H. S. TABER,
Corps of Engineers, U. S. Army.

B.—COMMERCIAL STATISTICS.

MELBOURNE, ARK., *July* 14, 1885.

SIR: The limit of the 20th instant being three days in advance of a mass meeting called at this place with a view to organizing in the matter of transportation facilities and for the purpose of collecting accurate statistics of tonnage according to careful investigation, we beg to submit the following in behalf of Izard County:

The actual tonnage at present paid for in the county and of which there is record approximates 2,000,000 pounds. In this nothing is included of cattle, lumber, and grain, a reasonable ascertainment of which, in pounds, it is impossible to arrive at until following the proposed organization. That it is not inconsiderable in the aggregate is borne out in the census reports of 1880, for of the whole area of the county under cultivation in farms 9,029 acres were in cotton, 21,728 in corn, 4,913 in oats, 4,830 in wheat, and to which at present date there is to be added a general increase of 30 per cent. Under the head of stock, the present freights (first class), the reduction is from $1.78 to $1.25 per hundred pounds. Any further information upon this head we shall be glad to furnish should you do us the honor of communicating your desires in the premises. It is the intention at our general meeting to memorialize our Congressman, Hon. S. W. Peel, and, his well-known devotion to his people being understood, it is anticipated that your Department will have his most zealous support as refers to our share in the matter of White River. The organization alluded to is to take place at Melbourne, on the 23d instant, and is to be a county branch of the "White River Transportation League."

With considerations for your eminent abilities, and, as throughout all Arkansas, with much gratitude for your mindful correllation of trying duties to the needs and exigencies of our commerce, we have the honor to be,

Very respectfully, your obedient servants,

R. L. LANDERS.
H. H. HINKER.
T. P. POWELL.
D. BROWN.
LANDERS & CO.

Capt. H. S. TABER,
U. S. Engineers.

V 7.

IMPROVEMENT OF WHITE RIVER, ABOVE BUFFALO SHOALS, ARKANSAS.

Before any work was ever done on this particular reach, the channel at low water was much choked by logs. In many places large bowlders rendered navigation dangerous or impossible, and, in numerous places, gravel and rock shoals existed, which held the water in pools. In short, it was a stream to which lock and dam or moveble dams could only be applied with any permanent success. The first appropriation was

one of $50,000, act approved June 23, 1874, and this applied not only to this reach, but all the way from Jacksonport. This money was expended in removing logs and the most dangerous bowlders and in improving the shoals by wing-dams, but appears to have been more largely expended below this reach, as per Major Suter's report. By an act approved August 14, 1876, $10,000 was appropriated for Buffalo Shoals. The first separate appropriation under this head was under act approved June 14, 1880, and in amount $20,000, and it was estimated that the total cost of the improvement would be $101,220, and this amount was to be largely used in improving shoal places. The next was under act approved August 2, 1882. and in amount $4,000.

To July 1, 1884, $23,181.63 had been expended on direct appropriations. How much of the others went to this reach cannot be determined from the records.

This expenditure has relieved navigation very much, but was too small in amount to cover only a few miles immediately above Buffalo Shoals. No money was expended during the year ending June 30, 1885, partly because of a desire to use plant in use elesewhere, but mainly to husband the small balance until the survey contemplated should show where it could be used to the best advantage. The survey was in progress at the close of the fiscal year ending June 30, 1885. To avoid repetition, all matter pertaining to this reach of the river that relates to how much can be profitably expended during the fiscal year ending June 30, 1887, and how this shall be expended and with what object, is placed under the general head, "Improving the White River, Arkansas," as it is understood that this heading is to be used in future for the White River improvement.

Total appropriations	$24,000 00
Amount expended to July 1, 1884	23,181 63

Money statement.

July 1, 1884, amount available	$818 37
July 1, 1885, amount available	818 37
Amount (estimated) required for completion of existing project	(*)

COMMERCIAL STATISTICS.

The commerce upon the White River during the past fiscal year is as follows:

Cotton	bales..	21,210
Cotton-seed	sacks..	35,000
Cotton-seed	tons..	510
Merchandise	do ..	10,575

This represents the amount actually carried by two steamers during the time specified. There are other small steamers doing a desultory trade, that would bring this amount up, but it is found difficult to get reports from them. This trade is principally below Buffalo Shoals. At present there is little or no traffic above Buffalo Shoals. Recent discoveries of rich mineral deposits in the upper White River Valley render it probable that great demands will soon be made on the river for transportation.

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* See "Improving White River, Arkansas."

V 8.

IMPROVEMENT OF WHITE RIVER, BETWEEN JACKSONPORT AND BUFFALO SHOALS, ARKANSAS.

Before any work was done on this reach of river its channel was much obstructed by logs, bowlders, snags, overhanging trees, and by gravel shoals. The natural channel, even at extreme low water, had in most places sufficient depth to meet the requirements of the boats navigating the river, provided that the above obstacles were removed. The original project contemplated the removal of these obstacles by snagging operations, by blasting, and by the erection of wing-dams. This was afterward modified so as to provide for a survey of the river and more thorough improvement thereafter. Up to June 30, 1884, $74,690.94 had been expended on this reach of river. This had removed many bowlders, improved the worst shoals, and cleared the river from Jacksonport to Batesville pretty effectually of snags, and reasonably so above Batesville, rendering navigation much safer, but much remained still to be done, especially between Batesville and Buffalo Shoals. Several of my predecessors had urged during this period the necessity for an accurate instrumental survey to determine what should be the final, radical, and complete improvement of the stream. As early as 1876 Major Suter set forth the desirability of such improvement, and submitted an estimate of $710,234.37 for the work.

During the fiscal year ending June 30, 1885, the small balance of $4,309.06 remaining of the total referred to above, was expended principally in snagging operations between Batesville and Buffalo Shoals, and, taken in conjunction with the new appropriation for improving White River, Arkansas, threw the work all to improving the shoals, which was begun, but suspended on account of high water. There was transferred to me by Maj. M. B. Adams, $4,309.06 July 3, 1884. Active operations were begun July 7, 1884, and continued until this balance was entirely exhausted, after which they were carried on under the general head of appropriation "Improving White River, Arkansas." Finding that a light draught, low power, steam-propelled snag-boat could be advantageously used both for snagging and the other purposes set forth in the original plan, authority was obtained to fit up the small steamer Picayune that was lying idle at Pine Bluff for this purpose. With little delay this boat was fitted for the field, and during the entire season worked so economically and effectually as to afford great relief to navigation, and to win high encomiums from the parties navigating the river. Snagging, cutting trees, and removing bowlders seemed to be of first importance to pave the way to improving the shoals, and the operations were confined to this work. This outfit did, in proportion to its cost, the best work of any outfit in the district, due to the economy practiced by Mr. E. F. Officer, assistant engineer in charge, whose report will be found appended. This boat carried a powerful Worthington pump and hose for grading, as practiced at Pine Bluff in 1881–'82. This pump was found to be of great assistance in working the boat over gravel shoals and enabling her to get at her work proper. In several instances absolutely impassable shoals were passed over in a very short time by the judicious use of this pump and its appliances.

Work proposed, statistics in regard to commerce, &c., will be found set forth under the general heading, "Improving the White River, Arkansas and Missouri." To avoid confusion, a money statement of this head of appropriation is made as follows:

Money statement.

July 1, 1884, amount available	$4,309 06
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	4,309 06
Amount (estimated) required for completion of existing project	(*)

EXPENSE ACCOUNT OF WHITE RIVER, ARKANSAS, BETWEEN JACKSONPORT AND BUFFALO SHOALS, FOR YEAR ENDING JUNE 30, 1885.

Pay-roll, labor	$1,812 68
Traveling expenses	95 85
Telegraph services	7 48
Subsistence supplies	941 23
Machinery	450 93
General supplies	773 40
Stationery	72 10
Lumber	20 54
Registry fees	9 60
Fuel	95 25
Office rent	30 00
	4,309 06

V 9.

IMPROVEMENT OF WHITE AND SAINT FRANCIS RIVERS.

The original condition of these rivers, the originally adopted project for their improvement are all to be referred to in reports under new heads of appropriation, which very properly separate two rivers requiring such different appliances for carrying on their improvement. There was turned over to the present officer in charge by his predecessor on July 3, 1884, a small balance of $724.67, which was expended in caring for property and in the running expenses of the snag-boat Wichita, which was transferred to the Saint Francis River, for one month. As the records of the office showed that the White River had already had its portion of the last appropriation, this balance was used in caring for property in the White River until the new appropriation for that river became available, and in bearing its proportion of the office expenses, and then the remainder was used in the running expenses of the snag-boat Wichita, which operated about one month on the lower Saint Francis, affording much relief to navigation by removing snags and cutting overhanging trees. All further matter relating to the future improvement of these rivers will be found under the new heads of appropriation, "Improving the White River, Arkansas," and "Improving the Saint Francis River, Arkansas." To avoid confusion a money statement is added to show how this appropriation has been exhausted.

Money statement.

July 1, 1884, amount available	$724 67
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	724 67
Amount (estimated) required for completion of existing project	(†)

* See "Improving White River, Arkansas."

† See "Improving White River, Arkansas," and "Improving Saint Francis River, Arkansas."

EXPENSE ACCOUNT, IMPROVING WHITE AND SAINT FRANCIS RIVERS, ARKANSAS.

Pay-roll, labor, &c	$507 00
Subsistence supplies	177 37
Fuel	31 26
Traveling expenses	15 04
Total	730 67

V 10.

IMPROVEMENT OF SAINT FRANCIS RIVER, ARKANSAS.

This appropriation was made by act approved July 5, 1884, and is the first separate appropriation made for the entire river. Earliest appropriation made for this river under any head was made by act approved March 2, 1833. Summing up all the various works of improvement, it may be inferred that, prior to 1833, this river was much choked with drift-piles, logs, and snags, and its waters spread out through a great variety of sloughs, while overhanging trees added to the difficulties of navigation. In the originally adopted project snagging operations figured largely, and attempts have been made to close up some of the many sloughs.

This river has been united so often with the White River, and also with the Black River, that, having no records in this office earlier than the First Annual Report of the Chief of Engineers, received after the entry of the officer in charge into the service in 1873, it is impossible to give exactly how much had been expended upon the Saint Francis River to June 30, 1884. After a careful study of House Ex. Doc. No. 64, Forty-eighth Congress, first session, the approximate amount is set down as not under $70,000, or over $100,000. This estimate should be given a weight 8 in a scale of 10. On July 1, 1884, the river was in an excellent navigable condition from its mouth as high as Wittsburg at medium stage of water. During high water boats have been as high as Lester's Landing. From Lester's Landing to Saint Francis the river was very badly choked with drift and divided into many channels, thus cutting off a rapidly developing section from all facilities of transportation.

The first project proper under this head was forwarded to the office of the Chief of Engineers, October 13, 1884, and received back, approved, October 21, 1884, and, briefly stated, provides that the $12,000 appropriated be expended in building a strongly-built decked scow, drawing from 10 to 12 inches of water, supplied with suitable appliances for removing obstructions, with accommodations for the working party, and that this boat be run about five months, wherever its services were most needed by the interests of navigation. The scow to cost not over $4,000, and her running expenses not to exceed $1,500 per month. After a careful investigation, from which it appeared that no interests of navigation would suffer so much by delay as they might by putting a weak force into the field, it was determined to let this work rest until the most excellent foreman and his unusually good force should have finished upon the Saline River. Moreover, it had become apparent that the personal supervision of the officer in charge, combined with the management of judiciously selected foreman, had resulted in building several boats in Little Rock at a marvelously low cost. These facts led

to the first work being begun upon the boat January 12, 1885, the earliest date at which the ways were available.

Great care was taken in the selection of material and in carrying the work forward. Special study was made of conditions under which the boat must work, which included the examination of an old boat that formerly worked upon this river. During this study it appeared that much greater work could be done by so-called hand snag-boats if they were given greater bearing surface under the bow, and greater strength of hull to take up the strains produced by the heavy weight suspended forward when a snag is being lifted. In constructing the boat, therefore, she was made broader than the chartered boats formerly used, and her bow was made longer, giving, in addition to greater bearing surface, more space to handle the snagging appliances. It may be added here that this arrangement has resulted in the boat's astonishing old river men, by handling one enormous snag already that had been abandoned by several previous outfits, and which alone has cost the loss of enough rafts to pay for the new boat two or three times over.

To give the hull necessary strength without bringing any frame-work above the deck was quite a difficult problem, but was finally successfully solved by a Mr. Bucher, by putting in three arches, well trussed, parallel to the longest axis of the hull, one attached to each gunwale and one on the central line. By the terms of the project approved in the Office of the Chief of Engineers, if it were possible to build the boat for $3,000 the outfit was to be made more complete by the purchase of a second-hand boat worth $2,000 at the nominal price of $1,000. This matter was compassed, and as this old boat had machinery on it worth $800 or more, the Saint Francis River now has an outfit that cannot easily be surpassed, and still has a balance of $268.74 of the $4,000 for the boat, which will be utilized in purchasing new machinery when the old becomes worn.

It should be borne in mind, as indicating what may be done by close supervision, that the present boat, which is known as the A. B. Johnson, is superior to the boats ordinarily built for $4,000, cost less than three-fourths as much, and has alongside of her a second boat for storage and for transporting pieces of logs, &c., to the banks worth at least $1,500, making a total valuation of plant as ordinarily estimated of $5,500, all at an actual cost of less than $4,000. It is believed that this proves that it was "most economical and advantageous to the Government to execute this work by hired labor and by the purchase of material in open market." The foreman who was to operate her being needed to build a quarter-boat at Forsythe, Mo., the boat after being completed was laid up from March 10, 1885, to May 3, 1885. As soon as this foreman was available the outfit of the boat was completed, and she left for her work May 21, 1885. From that time to the close of the fiscal year she pulled 196 snags, cut 653 overhanging trees.

Her manifest capacity has secured for her the most hearty co-operation experienced in this district. With one exception the river boats have towed or will tow her from position to position without charge, and the citizens of the upper river maintain a pilot upon her at their own expense, that the money may go as far as possible in snagging operations. The present appropriation will be used as judiciously as possible to open a narrow channel as high as Saint Francis, Ark.

To maintain and widen this will require at least $8,000 annually for several years. There is no river in the State that is more worthy of improvement in the interests of navigation. The more study I have given

the stream and the country the more interesting the study becomes, and the more convincing the arguments in favor of opening up the river. With no transportation except the wagon, a fertile section rapidly settling up between Lester's Landing and Saint Francis would at once pour out through this channel its products, adding many times the sum required for the improvements to the material prosperity of the country.

Whatever decision may be rendered as to the desirability of further expenditure, the river now has a plant of its own, peculiarly adapted to its work, and can be cared for at a very small outlay. It would be better to put the river in excellent shape before the plant deteriorates, and it is believed that after a few years of thorough work the river will maintain itself. As to future demands, the development of the country can alone decide what these will be. It may be that dredging the sunk lands to bring the river back to its own channel may be warranted in years to come, and that low-water navigation may be demanded. At present the prospect is too remote to devote time to plans and estimates for these improvements.

Letters were sent several weeks prior to the 1st of July, to several parties interested in the river, for statements of the commerce, but no answers have been received, so that the statistics as given in former years are again submitted.

Cotton	bales..	28,000
Cotton-seed	tons..	15,100
Corn	bushels..	5,000
Miscellaneous freight	tons..	10,000

Money statement.

Amount appropriated by act approved July 5, 1884		$12,000 00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$7,462 58	
July 1, 1885, outstanding liabilities	932 10	
		8,394 68
July 1, 1885, amount available		3,605 32
Amount that can be profitably expended in fiscal year ending June 30, 1887 Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.		8,000 00

EXPENSE ACCOUNT IMPROVING SAINT FRANCIS RIVER, ARKANSAS, FOR YEAR ENDING JUNE 30, 1885.

Pay-rolls, labor, &c	$4,034 88
Traveling expenses	129 88
Subsistence supplies	443 57
General supplies	906 23
Lumber	512 23
Fuel	243 88
Furniture	135 52
Office rent	30 00
Skiffs	25 55
Express	60
Telegraph services	24
Snag-boat and supplies	1,000 00
	7,462 58

V 11.

IMPROVEMENT OF SALINE RIVER, ARKANSAS.

Before any improvements were made in this river its channel was obstructed by snags, logs, drift-piles, and overhanging trees, and by shoals.

The original plan for the improvement of this river contemplated the rendering of its channel navigable as high as practicable (or as commerce demanded) by the removal of snags and logs and by cutting overhanging trees, and then further improvement of the shoals if the commerce warranted. There was expended upon this river up to June 30, 1884, $15,867.18. This had given much relief to navigation, but there still remained between Longview and the mouth many obstructions of the classes named. During the fiscal year ending June 30, 1885, $5,074.52 have been expended. This has practically cleared the river of snags, overhanging trees, logs, and drift-piles. My predecessor, Maj. M. B. Adams, transferred to me $632.82 on July 3, 1884. Active operations had then been begun, and these were continued without interruption until December 20, 1885. The boat and plant found on the river was continued in use until the new appropriation became available. It was then deemed more economical to build another boat to work with it. This was accordingly done in accordance with plans approved by the Chief of Engineers, and, as a result, this outfit made a record of which any hand snag-boat outfit need not feel ashamed. An experienced foreman, who has been in this district six or seven years, Mr. E. C. Wiley, had charge of this work, and despite the heat and fever has placed the river in most excellent condition. Work was suspended for lack of funds December 20; a small balance of $649.53 being reserved for the care of the property until final action may be taken on the question of further improvement. The report of Mr. Wiley is appended and marked A. This gives, in a concise form, the details of the work. I would simply invite attention to the excellent record of this outfit. During the season 1,200 logs and snags were removed from the stream, 3,985 overhanging trees were cut down, and 1,463 trees deadened. Too much praise cannot be given to Mr. Wiley for this work. He has been in the district several years, and I can but note that could the appropriations but be made continuous on all works from beginning to completion, thus enabling us to retain experienced men, as in this instance, it would be a great gain to the public service. It will be seen from Mr. Wiley's report, also, that at present there is but little commerce upon the river. That this stream will at some time be a valuable artery of commerce there seems little room for doubt; but at present the country is not sufficiently settled. It would seem advisable, now that it is pretty well cleaned out, to watch the result in the way of developing the country before another appropriation is made. For a year or two the river will remain in its present condition, and this will give time to see whether it will be improved by the boats, and then from $5,000 to $6,000 a year could be profitably expended in securing an open river as far up as Driftwood. The fact that the railroads now take the freight is no argument that the river no longer is needed. With ample facilities for water transportation this freight is very likely largely to return to the river, but whether it does or not, sound public policy requires that the cheaper modes of transportation be placed within the reach of producers wherever practicable. While, therefore, no appropriation is recommended for the year ending June 30, 1887, the question of further improvement is left contingent upon the results of the work

done so far. The commerce of the river is represented by 1,200 bales of cotton and a smaller quantity of return freight—this for the past season.

Money statement.

July 1, 1884, amount available		$632 82
Amount appropriated by act approved July 5, 1884		5,000 00
		5,632 82
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$5,074 52	
July 1, 1885, outstanding liabilities	10 00	
		5,084 52
July 1, 1885, amount available		548 30

EXPENSE ACCOUNT OF APPROPRIATION FOR IMPROVING SALINE RIVER, ARKANSAS, FROM JULY 1, 1884, TO MAY 31, 1885.

Services of foremen, clerks, and laborers	$3,410 93
Subsistence supplies	741 02
Snagging supplies	215 32
Hardware	221 59
Stationery supplies	114 02
Hire of teams	93 90
Lumber	67 14
Freight	45 00
Traveling expenses	72 60
Office rent	90 00
Repairs to boiler	3 00
	5,074 52

A.—REPORT OF MR. E. C. WILEY.

UNITED STATES ENGINEER OFFICE,
Little Rock, Ark., December 31, 1884.

CAPTAIN: I have the honor to very respectfully submit the following report of operations on the work of improving Saline River, Arkansas, under my charge from July 1 to the close of active work, December, 20, 1884. The funds available for this work July 1 were sufficient to remove only the worst obstructions to navigation on that part of the stream below Godfrey's Landing, upon which there had not been any work done heretofore, and is practically the only part of the stream in which steamboats ply. This work was carried on with the appliances on hand—a quarter-boat with a crab on the bow used for removing snags and logs—until the receipt of your letter of July 19 informing me that $5,000 additional had been appropriated for the continuation of work on the Saline River. It was then deemed expedient to improve the outfit by building a strong flat-boat and removing the engine belonging to this work from Pine Bluff to the river. The most convenient place for constructing such a boat was found to be about 40 miles from the mouth of the river at a point known as "Moore's Old Mill." This was also the most convenient place for getting the engine to the river.

Authority for the construction of the boat and removing the engine was received August 23, and I at once set about the work of building it. The boat was completed September 9 at a total cost of $338.75. The engine was put in place and everything ready to resume active operations September 13. On the 15th I started up the river removing all overhanging trees, logs, and snags that endangered navigation. It was soon found that the new boat and engine was just the thing needed for effective work on this stream, and would enable me to perform four or five times as much work as I could have done without it, at no greater cost for labor and with much more satisfaction to every one engaged in the work.

Operations were carried on as far up the river as Driftwood, which point was reached September 30. The necessary work being done at Driftwood, on the 11th of October I dropped the boats down to where the work-boat was constructed, and after taking

on supplies moved on down the steam, removing all the logs, snags, and overhanging trees, to the mouth of the river. The stage of water was the lowest known for many years, making it necessary to remove many logs from the shoals in order to get the boats along that otherwise need not have been removed. The boats were brought up the river and all the property put in good shape and turned over to Mr. S. W. Godfrey, at Godfrey's Landing, December 20, 1884. During the season there were 1,200 logs and snags removed from the stream; 3,985 overhanging trees were cut down and destroyed by having all the limbs trimmed off and the trunks cut into short lengths, and 1,463 trees were deadened.

The stream in its present condition can be navigated with safety, at a medium stage of water, by boats with a carrying capacity of 500 bales of cotton, as far up as Long View, and at a high stage of water as high up as Mount Elba, about 10 miles below where the Texas and Saint Louis Narrow Gauge Railway crosses the river on one continuous span of bridge. As to commerce on the stream there is very little since the completion of the Little Rock, Mississippi River and Texas Railway to Warren. The time that boats can get up the river being so uncertain, planters being anxious to market their crops as early as possible, and the roads being in good condition for hauling, the most of the cotton that formerly found a market down the Sabine River is now hauled to the railroad, planters preferring to haul a long distance over a good road to a short one over roads in as bad condition as they get to be after sufficient rain has fallen to open navigation in the river. Last season there were, as nearly as I could ascertain, only 1,200 bales of cotton carried out of the stream. The incoming commerce was much less.

Up to the time the work closed this season there had not been a boat in the stream. Some parties were expecting one to come up as far as Godfrey's Landing, where there are a few bales of cotton awaiting shipment, but no one with whom I conversed expected a boat would go any higher up the river than Godfrey's Landing.

There will be four or five flat-boats loaded with staves run out of the river this winter. I am informed by timber men that most of the timber suitable for making into staves, contiguous to the river, had been used, and they would have to seek elsewhere for timber. Some rafting of pine and cypress is carried on, but I had no means of ascertaining how much. With regard to future appropriations, should there be any made, I would respectfully suggest that the money be expended between Driftwood Cut-off and Warren, in removing any drift that may have accumulated and trees that may have fallen in along caving banks since any work was done on that part of the stream.

Very respectfully, your obedient servant,

E. C. WILEY.

Capt. H. S. TABER,
Corps of Engineers, U. S. A.

V 12.

IMPROVEMENT OF L'ANGUILLE RIVER, ARKANSAS.

This river, like all the streams in eastern and southeastern portions of Arkansas, before being improved was obstructed by logs, snags, and overhanging trees, and the shoals incident to the accumulation of snags and logs.

The original plan of improvement, begun in 1879, contemplated the removal of these obstacles, and up to June 30, 1884, $13,850.53 had been expended with this object in view, and had been so judiciously used that, during the fiscal years ending June 30, 1884–'85, the small balance, $3,149.47, held to further clear the channel was not drawn upon. There begins to be need of some work, and during the year ending June 30, 1886, it is proposed to use as much of this balance as may be requisite to meet the demands of commerce. This river and the Saint Francis have so much in common that in preparing the outfit for the latter the wants of the L'Anguille have been kept in view, and it is believed that the plant now in use upon the Saint Francis can be turned to excellent account under proper authority in putting the L'Anguille in good navigable condition. There will be no cost for transfer, and the trained

force of the Saint Francis can be put in without a break and the interest of commerce most thoroughly cared for very economically. Heretofore outfits have been hired. This district is now well equipped with plant and good results may be expected. From all that I can learn the balance available is ample for all present contingencies; therefore no further appropriation is recommended at present.

COMMERCE.

Letters were sent several weeks prior to the 1st of July to parties interested in this river, for statistics in regard to the commerce, but no answers have been received, so that the statistics as given in former years is again submitted. "The commerce is represented by 6,000 bales of cotton, besides cotton-seed, hides," &c.

Money statement.

July 1, 1884, amount available	$3,149 47
July 1, 1885, amount available	3,149 47

V 13.

SURVEY OF THE ARKANSAS RIVER, ARKANSAS, FROM LITTLE ROCK TO ITS MOUTH.

The original plan for this survey was drawn by my predecessor, Major Handbury. His estimate called for $21,000. Only $19,000 were appropriated by the act approved July 5, 1884.

Major Handbury's project contemplated the covering the river with a series of triangles, determining the shore-line, both at high and low water, the position of the bars and islands, the general topography of the valleys to the bluffs when these are not too far from the river, the depth of the water, the gauging of the water at various points and principal tributaries, the nature of the soil and character of the river-bed cross-sections to be made at frequent intervals. The slope to be accurately determined and all other attainable data to be collected that will bear upon the problem of the permanent improvement of the navigation of the river. Though but $19,000 had been appropriated it was determined to take the season when the leaves were off, select energetic men, and undertake to carry out substantially the above project. Work was begun in December and successfully completed in April, and after the notes are worked up there will be a balance of $1,200 to $1,500 saved to this appropriation.

Much credit is due Mr. C. E. Taft for the energetic manner in which he pushed the work forward. His report will be found appended, marked A.

Assistants were at work completing the maps at the close of the present fiscal year.

As noted elsewhere, this survey completes the survey of the Arkansas River, for the entire navigable reach. In the case in hand, in which the survey extends from Little Rock to the mouth, it will be possible with the funds available to put the maps in shape for ready reference after the manner of similar maps of the Missouri River. In the case of the S. T. Abert survey of 1869, from Little Rock to Fort Gibson, and the survey completed this season, from Fort Gibson to Wichita, Kans., it will require

about $1,500 to put them in this shape, they now being in large sheets upon heavy paper. It is recommended that the balance remaining after the maps under this head are completed be made available for this work, and that a special appropriation be made for the balance. Every effort has been made to get the maps forward, but as they are only completed for the lower portion of this survey plans of improvement are submitted for a few miles in a typical way only, complete plans to be submitted as rapidly as the forwardness of the map will admit, and as they may be desired. The works are not definitely located, as, from the nature of the stream, which is ever shifting its channel, this should only be done when the works are to be put in. These maps are rather historical than likely to give an idea of the real boundaries of bars, islands, and banks for any length of time. New surveys will be required as the works go down. This survey will enable the engineer to see what the river has been doing in the interim, often a very desirable bit of information in dealing with alluvial streams.

All the details of this survey are so well set forth in the report of Mr. Charles E. Taft, assistant engineer in charge, that it is only necessary to refer to them here. The maps will be forwarded as soon as prepared. There is forwarded herewith one reduced copy of the field charts, which is used to illustrate not only the form in which the maps will be ultimately forwarded, but also how it is proposed to improve the river. There is also forwarded a tracing of the full-sized heavy paper sheets showing the typical works in plan. A section of the sheet only is traced. It should be borne in mind that in this particular instance the maps forwarded show how this reach was to be improved July 1, 1885. It is necessary to state this distinctly, inasmuch as while the methods would be the same after another heavy rise, the exact location of the works might be radically changed and can only be located for each particular reach by a survey immediately preceding the erection of the works. This being an alluvial stream, the reasons for making this reservation are too well known to require enumeration here.

PLAN OF IMPROVEMENT.

It is always more desirable and satisfactory in every way to the engineers who prepare plans and give estimates to have the necessary preliminary data all before them. There are cases, however, in which the interests involved are such that to wait for the preparation of such data results in so much loss or disadvantage that it becomes necessary to select certain parts of such data known to be complete, and also typical of the whole eventually to be prepared, and having drawn plans and prepared estimates for this, to make a more or less accurate forecast of what the total amount will be. In the case in hand it will be a month or more before all the data secured by the survey will be in shape to be used in preparing plans and estimates. For a long period temporary expedients, involving large outlay, have been resorted to in order to tide the river along until plans could be prepared for its permanent improvement. It would seem binding on this office, therefore, to make strenuous efforts to prepare plans and estimates at the earliest moment practicable. The above considerations have led to the preparation of the following plans during a busy season, when, under ordinary circumstances, their preparation would not have been undertaken. The plan of improvement, as set forth herein, contemplates a channel at least 200 feet wide and 6 feet deep at low water, or the zero of the Signal-Service gauge at Little Rock, Ark., from Little Rock to the Mississippi

River via the White River Cut-off. The low water taken in this instance probably occurs only once in twenty years, the average low water being probably at least 2 feet higher. Plans and estimates cannot be given at present for the upper portion of the river, for the reason that the maps are not sufficiently completed. These have been prepared by extra effort in a very busy season, and the right is reserved to modify them within certain limits if further study develops the necessity or desirability of so doing.

The methods adopted are those used upon the Mississippi River for contracting the channel, and consisting of primary and secondary hurdles, so placed as to cause deposits and eventually contract the low-water channel. These are to be built to a height of 16 feet above mean low water, and to be in every respect similar to those used at Twin Hollows, and at Horse-Tail Bar on the Mississippi River. One of the worst reaches of the river is shown on Plate I. The positions of the hurdles are shown therein as they would be built to-day. Similar studies have been made of all the other reaches, and from these studies it is estimated that to improve the river upon this plan from the Mississippi River to Troy Landing, 18 miles below Little Rock, will require 172,700 feet primary hurdles, which, at $8 per foot, will cost $1,381,600; 145,550 feet secondary hurdles, which, at $6 per foot, will cost $873,300. The soundings from Little Rock to Troy Landing not being plotted, this reach cannot be so well estimated for, but it may be safely put at $283,644.

This makes a grand total of $2,538,544. Of this it is estimated that $250,000 can be profitably expended during the fiscal year ending June 30, 1887.

MAPS, ETC.

There are three tracings accompanying this report.

One shows upon a reduced scale the work already completed upon two of the large sheets of the survey, and also shows the position of the proposed works of improvement. It is marked Plate II.

Another tracing, marked Plate I, is an exact copy of a portion of one of the field maps, and shows more clearly the position of the proposed works.

Plate III shows the details of the hurdles.

So far as I can learn, the heaviest packets designed for the river trade draw but 5 feet of water. Six feet would therefore seem to be ample depth to provide.

It is believed that when the works are actually erected they will not need to be extended as far as laid down, as observation has shown that under favorable conditions it is possible to extend a bar in this river well below the works. In preparing estimates, however, it was deemed best to provide for the extreme cases, where it is necessary to erect works almost as far as the deposit is desired.

Money statement.

Amount appropriated by act approved July 5, 1884		$19,000 00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1883	$17,069 29	
July 1, 1885, outstanding liabilities	292 50	
		17,361 79
July 1, 1885, amount available		1,638 21
Amount (estimated) required for completion of existing project		500 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		250,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

EXPENSE ACCOUNT FOR SURVEY OF ARKANSAS RIVER, ARKANSAS, FROM LITTLE ROCK TO ITS MOUTH.

Pay-rolls, labor, &c	$12,178 72
Subsistence supplies	1,961 08
Instruments	573 80
Office-rent	30 00
Freight and express	12 65
General supplies	482 07
Fuel	213 61
Furniture	481 84
Granite and stone posts	64 75
Lumber	476 66
Traveling expenses	81 53
Telegraph service	1 24
Skiffs, yawls, and oars	290 30
Stationery	230 04
Total	17,078 29

A.—REPORT OF MR. CHARLES E. TAFT, ASSISTANT ENGINEER.

LITTLE ROCK, ARK., *June* 1, 1885.

CAPTAIN: I have the honor to report the completion of the field work of the survey of the Arkansas River from Little Rock to its mouth. The main portion of the notes taken, covering the triangulation and shore lines, were plotted in the field, as shown by the charts submitted. Topographical details were not filled in for lack of time.

The volume of the river is divided, in an ordinary stage of water, at the White River Cut-off, one portion going through the cut-off and White River, the other through the old outlet of the Arkansas to join the Mississippi. The survey was carried by both routes, and monuments established at the points of junction with the Mississippi.

ORGANIZATION OF THE SURVEY.

The survey was organized in Little Rock in December, 1884, under the immediate supervision of the United States Engineer office, the working force consisting of ten assistant engineers and thirty-seven men. The quarter-boat Lizette was constructed expressly for the use of this party, and was fitted with necessary conveniences to make it a comfortable living place during the survey. It proved rather too small after the warm weather set in, but proper attention to sanitary measures kept the party in good health throughout the entire survey. A yawl for the use of the sounding party, and four skiffs for the other parties, were furnished with the outfit.

A flat-boat that had been used in the survey of the upper river was turned over to this survey for use as a store-boat. This boat was lost on the 30th of January by foundering, while insecurely fastened, and was crushed by the drift running in great quantities during a high rise of the river. At the same time were lost three skiffs, the yawl, and a quantity of the stores kept on the flat-boat. The survey was put in my charge on the 2d of January, 1885, and new outfit of skiffs furnished, together with necessary stores to replace those lost.

The transit lines of the survey had been advanced as far as Fourche Bayou, about 14 miles from Little Rock, when the loss of the boats and stores occurred. It was immediately discovered, upon my assuming charge, that the survey could not be advanced, from the fact that several of the triangulation stations that had not been occupied had been washed away by the same high water that had wrecked the boats. It was therefore necessary either to do the work all over again or commence where we were and connect the old work with the new. The latter plan was decided upon, as it would save much time. A carefully-measured base was put in near Troy Landing, and from this a series of triangles developed to the stations of the earlier work that had not been disturbed. In order to accomplish this, 8 miles of the river had to be retraced. The ends of the base line were marked by permanent stone monuments, with the initials "U. S." cut in them.

Observations for latitude and azimuth were taken at this new base, which was also a verification of the first one put in at Argenta, opposite Little Rock. From this new base the survey was advanced as rapidly as possible to its completion, without further serious accident or hindrance, other than is encountered by all similar work in an unsettled and timbered country.

METHOD OF SURVEY.

The general scheme of the survey, as outlined in an order from the Engineer office, was a triangulation embracing the river. A transit party on either bank meandered the shore and tied their lines to the triangulation stations as they came to them. They also set out and located sounding flags at convenient distances for the use of the sounding party, and noted the topography near the shore.

Compassmen, one on either bank, took the topography back from the river, embracing an area of 2 miles from the transit lines, tying their lines to the regular transit stations. The soundings were made in continuous sections by traversing the river from side to side. The positions of the boat were located by intersection, two observers at different stations reading the angles with sextants at a given signal. In all measurements the stadia was used, excepting the triangulation work. Care was taken to frequently test the adjustment of the wires by comparing the stadia distances with the stations of a check line measured with the steel tape, and also by distances between triangulation stations. Levels were carried on both sides of the river, starting from a common datum at Little Rock. The duties of the levelers were to take the elevation of the water at every sounding flag where practicable, and the height of the bank, to establish the zero of the gauge wherever the quarter-boat was located, and to make bench marks at distances of about 1 mile apart. Their work was checked by reciprocal leveling, and agreed very closely at the final test made at the mouth of the river.

The sounding party, besides the regular duty of river sounding, examined the channels of old rivers that communicated with the main river, and they also took observations at different points for estimating the discharge, using a surface-float for velocity.

In setting out the triangulations stations, the rule was to make the triangles as well proportioned as possible, using no angles less than forty degrees; but in many cases it was necessary to disregard this rule, in order to forward the work through narrow portions of the river, or where dense cottonwood growth on the bars or heavy forest trees and masses of vines would have delayed the survey for days awaiting the cutting out of lanes through them. In the triangulation work every angle was measured separately, and six pointings were made at every angle. The notes were all reduced in the field.

The final test of the triangulation work obtained by comparing the calculated length of a side of the last triangle and the measured length of the same side was of a character that proved that no important error had been made in the readings. The actual difference found between the calculated and measured side was 12 feet, after running 158 miles from the base.

THE COUNTRY.

The country through which the river passes is flat and uniform in character for nearly the whole distance from Little Rock to the Mississippi. The high ground is left at Little Rock, and is not met with again until at Red Bluff, and White Bluff, and again at Pine Bluff a spur of the higher ground reaches out into the delta and confines the river on one side. The banks of the river range from 5 to 25 feet in height above the ordinary stage of water, the average being about 15 feet.

The highest point of land along the river was met at White Bluff, 107 feet above the water-surface in the stage we found it. This was on the bluff side of the river. The opposite shore is flat and low. The elevations of the bank at various points along the river are given in the table of distances accompanying this report. The soil is generally a rich sandy loam in the upper part of the river. Further down is seen more of the clay loam known as "buckshot," a rich soil but requiring particular care in its preparation for a crop, and taking its common name from the peculiar manner in which it breaks up under the influence of the atmosphere. Further down the river are found the formations of recent deposits, with a subsoil of the tough stony clay seen forming the hills of Red Bluff and White Bluff.

At Arkansas Post and again at the Indian Mounds the grand prairie approaches nearly to the river. The soil is everywhere extremely fertile, raising fine crops of cotton or corn, excepting in the grand prairie, which is only good for grazing purposes. The past record of the farming section bordering the Arkansas is that of one of the best to be found for southern staples. It still maintains that character in the upper part of the river and wherever the levees are well kept; but in recent years the river has been allowed to have its own way to such an extent in the section of country in the lower part and near the mouth, that many fine plantations are giving over to the rank growth of weeds and vines that very soon cover neglected clearings in that rich soil. There is comparatively little of the country bordering the river that is not subject to overflow, necessitating constant care of the levees. Some land is cultivated at risk of overflow, and if the year is favorable a good crop is the result; but an unusually high rise, or an unseasonable one, will render futile the

labor of the planter. This is greatly due to the shape of the country back from the river, as it slopes down in receding from the shore, making depressions in which the water can stand to form marshes if allowed to enter, and converting the country for miles into a vast swamp. The immediate banks of the river have the form of levees in many places and for long distances, being ridges heaped up by deposits from successive overflows. If this condition of submergence were of long continuance, the land would be untillable and the country uninhabitable. Fortunately, the floods soon subside from the natural effect of the slope of the river-bed; but there is a large area near the mouth where the river not only pours its own volume over the banks, but those also of the White and Mississippi are added to it. The three, when combined, make a flood that will at times stand so long that its effect is seen in the rootlets that certain kinds of trees have thrown out from their trunks at a distance of 6 to 8 feet from the ground, while covered at that height with water for weeks. These rootlets hang down like bunches of moss in the dry season, presenting an odd appearance. A good levee once protected the plantations in the lower river, and they gave to commerce thousands of bales of cotton every year, where now there is no production. This section of the country is fast reverting to the wilderness from its subjection to the river, which is like an untamed animal without check or hindrance to its love of destruction.

The lower country is, however, subject to malarial poison, and although the land is so rich and fertile, it is really unfit for living in without the long process of acclimatization only possible to the native. The negro race seem to luxuriate there, finding no serious effects from malaria, and they are the only people that could clear up the wild land. There is much valuable timber along the river, represented by several varieties of oak, pine, ash, cypress, holly, pecan, gum, and many others. The sweet-gum, of which there is an inexhaustible store, is just beginning to find favor with cabinet-makers, replacing black walnut, and at no distant day will be in demand. The supply of timber of all kinds is very great, not so much attention having been paid to getting it out for shipment in recent years. Cotton being the dependence of all planters, it is of all crops the easiest to convert into cash, and the whole extent of bottom, excepting the prairie section, is the best of cotton land when cleared. It needs only proper safeguards against the encroachments of the river to make a great extent of country fit for the settlers that can raise cotton and safe for planters to make the land ready for crops at stated periods, knowing that their labor may not be neutralized at any moment by the river.

THE RIVER.

The contour of the river is a succession of great bends or curves, sometimes as reverse curves, but generally united by tangents. The action of the river is to cut these bends at the turn, making them after a time into the form of loops, and in the end cutting through the narrow neck of the loop to form a cut-off, through which the current passes with the increased velocity imparted to it by lessening the distance without changing the fall. The old bend or loop thus cut off is gradually converted into a lake as its entrances become filled up with sand, and it is known as an old river. The cut-off thus formed, by giving increased velocity to the river current, commences immediately the formation of another bend below its new mouth, or changing the form of the one already existing, by cutting the bank against which it is thrown with new force and in a new direction, breaking it down more or less rapidly, depending upon the volume of water that each successive rise brings down.

It is the varying velocity of the current that gives it such power to change the shape of the banks. From Little Rock to the White River Cut-off there are sixty great bends, of which there are ten that have been changed to the form of loops, and three of these loops will by the natural action of the current be cut off within the near future, unless means are taken to divert the direct force of the current away from the caving banks.

From the White River Cut-off to the Mississippi by the old channel of the Arkansas there are seven bends in the distance of 15 miles. None of these have taken the loop form, but there is one very sharp bend that will, without doubt, soon change to that shape, or be worn away until the point of the turn is rounded into an easier curve. The White River Cut-off has four sharp bends in the distance of 5 miles. The subsoil here is evidently of very tenacious material, or it would have been worn into a straight channel long ago. In that portion of White River through which the Arkansas sends part of its volume to the Mississippi there are five bends from the cut-off, none of them in the loop shape. The banks are of the same material as the cut-off, and although they are caving to a certain extent, and the river does change its shape, yet it is not subject to the sudden and destructive changes that mark the Arkansas. The old channel of the Arkansas is also more stable than the main river. This may result from the fact that its banks are not constantly worn by the full force of the powerful current, as part of it goes through the cut-off.

The banks of the river are everywhere subject to erosion under the action of the current, and are known as caving; at some places they are less liable to break down than others; the tough clay resists for a time, but yields at last when the full force of the current is directed against it and maintained for a number of rises. The sinking of drift and the deposition of sediment, as in all rivers, forms bars which are liable to be changed by the current, or which deflect the current, making changes in the navigable channel.

Snags collect in the channel and render navigation dangerous if not removed. At every bend in the river there is an eddy produced behind the point around which the river is moving; in this slackwater is deposited a certain amount of the sediment held in suspension, and a bar is gradually built up, while on the opposite shore the current has full sweep, and makes a caving bank; these are the characteristics of every turn in the river—a bar fronted by a caving bank. The bar is gradually overspread with a growth of cottonwood or willow, and is built out into the river, as the other bank is cut away. In the reaches or tangents between the bends, the eddies and cross-currents produce bars in the river that grow into islands or are shifted in position according to the action of the current.

The volume of the river changes very suddenly in every rise, and changes are produced in the shape of the bars and caving banks by every flood that passes. During the survey the river was never at a stand for twenty-four hours at a time. The gauge would show it either rising or falling every day. The continual reading of the gauge kept at the quarter-boat shows that the total fall exceeded the total rise by 9 feet during the three months the boat was moving from Troy Landing to the Mississippi. The position of the boat was frequently changed as the convenience of the work demanded, and our records were made wherever tied up.

The zero of the gauge was established wherever practicable.

The difference of level between the water-surface at Little Rock and the mouth of the river at the Mississippi by the old channel is 98.81 feet as given by the levelers. This reduced to low-water plane by reference to the gauges at Little Rock and the mouth of the river shows a fall of 115.70 feet. The distance is 176.4 miles by the shore line, showing an average fall of 0.656 of a foot per mile. This slope is not uniform, however, as shown in the accompanying table of distances, but it is nowhere so great as to produce rapids or a current too strong for navigation. In the lower part of the river the current is sometimes neutralized by a high rise in the Mississippi and White rivers as far back as Auburn. The corrected elevations to obtain the slope in the accompanying table were made by changing the levelers' notes taken at specified dates by the amount of oscillation in the river-surface during those dates, as indicated by the quarter-boat gauge.

Gauge records were kept during the progress of the survey at Little Rock and Pine Bluff, and we make use of the records of the established Mississippi gauge located at the mouth of White River by referring its zero to our datum.

The difference in elevation between the zero of the Mississippi gauge and that of Little Rock is 115.7 feet. If the first has been established with reference to the Gulf, we can at once obtain the elevation of Little Rock above tide-water. This elevation is given by railroad surveys as 225 feet.

The data for comparing these figures with the Mississippi have not been obtained.

Names of places and landings.	Number of miles from Little Rock.	Elevation of water-surface during survey.	Difference elevation, corrected from gauge reading.	Distance in miles.	Slope.	Total difference elevation of water-surface during survey.	Elevation of ground.
Argenta	0.0	305.91	.....	.....	.....	.....	321.73
Well's Ferry	8.8	.....	.....	.....	.....	.....	.....
Troy Landing	17.8	291.54	.....	.....	.....	.....	305.34
Wayne's Landing	18.4	291.72	14.19	18.4	0.77	14.19	.....
Eagle Landing	20.1	289.11	.....	.....	.....	16.80	301.50
Waring's Landing	22.6	284.50	.....	.....	.....	21.41	.....
Wampoo	26.4	282.73	.....	.....	.....	23.18	301.00
Red Bluff	33.7	277.78	13.20	15.3	0.86	23.13	347.25
Siler Landing	36.2	275.60	.....	.....	.....	30.31	.....
Wild Cat	38.4	270.23	.....	.....	.....	35.68	.....
Brodie's Landing	40.9	268.47	5.39	7.2	0.74	37.44	290.00
King's Landing	41.4	266.92	.....	.....	.....	38.99	.....
Hensley's Ferry	42.1	266.17	.....	.....	.....	39.74	.....
Moke's Landing, White Bluff	43.1	265.52	1.27	2.2	0.57	40.39	371.00
Browndale Landing	46.8	263.54	.....	.....	.....	42.37	.....
Eastwood Creek	49.2	261.39	4.13	6.1	0.67	44.52	281.00

Names of places and landings.	Number of miles from Little Rock.	Elevation of water-surface during survey.	Difference elevation, corrected from gauge reading.	Distance in miles.	Slope.	Total difference elevation of water-surface during survey.	Elevation of ground.
Pastoria	51.5	260.83	.....	.....	.....	45.08	285.00
McAlister's	55.2	259.60	1.79	6.0	0.30	46.31	281.00
Bell's Ferry	61.8	256.56	.....	.....	.....	49.35	.....
Pine Bluff	65.9	254.13	4.07	10.7	0.38	51.78	294.47
Vaugine	71.9	252.34	.....	.....	.....	53.57	271.00
Fairview	73.1	252.11	3.32	7.2	0.46	53.80	271.00
Rob Roy Bridge	75.4	251.11	.....	.....	.....	54.80	274.00
Davis Landing	77.9	254.87	1.79	4.8	0.37	.....	.....
Astor Point	80.3	254.34	.....	.....	.....	.....	269.13
Hall's Ferry	81.2	253.93	2.22	3.3	0.67	.....	.....
Bronson's Landing	84.2	252.09	.....	.....	.....	.....	.....
Bankhead	88.4	247.88	4.31	7.2	0.59	58.03	260.34
Garretson's	89.7	.....	.....	.....	.....	.....	.....
Greenback	90.9	244.92	.....	.....	.....	60.99	258.00
Swan Lake	93.4	241.21	3.07	5.0	0.61	64.70	251.00
Sarassa	97.5	239.07	.....	.....	.....	66.84	250.00
Racine	99.4	238.62	.....	.....	.....	67.29	250.00
Williams	100 4	236.26	4.43	7.0	0.63	69.65	251.00
Mud Lake	102.5	232.98	.....	.....	.....	72.93	249.50
Heckatoo	103.9	232.48	.....	.....	.....	73.43	248.00
Cummings	105.0	231.03	.....	.....	.....	74.88	247.00
Little Bayou Meto	105.0	230.87	4.27	4.6	0.92	75.04	.....
Auburn	111.5	227.04	.....	.....	.....	78.87	246.00
Douglas	112.3	225.14	3.78	7.3	0.51	80.77	243.00
Samples	117.9	221.77	.....	.....	.....	84.14	237.00
Bayou Meto	120.3	220.71	4.35	9.0	0.48	85.20	235.00
South Bend	122.9	220.25	.....	.....	.....	85.66	235.00
Cook's	129.3	224.08	.....	.....	.....	.....	234.00
Silver Lake	130.0	223.80	5.80	8.7	0.66	.....	232.00
Riverside	128.6	224.59	.....	.....	.....	.....	233.00
Pendleton's	131.8	223.61	.....	.....	.....	.....	232.00
Arkansas Post	137.8	219.76	5.37	7.8	0.68	86.15	237.00
Fletcher's	144.2	214.79	.....	.....	.....	91.12	226.00
Burnet's	147.9	211.56	5.26	10.1	0.52	94.35	224.00
Red Fork	148.6	210.66	.....	.....	.....	95.25	.....
Painter's	151.3	209.94	.....	.....	.....	95.97	226.20
Hopedale	153.5	208.84	3.05	5.6	0.54	97.07	.....
Wardell's	155.7	208.69	.....	.....	.....	97.22	.....
Cut-off	160.6	208.36	1.10	7.1	0.15	97.55	.....
Mississippi by White	173 4	202.99	4.88	7.8	0.62	.....	215.50
Mississippi by Arkansas	176.4	207.10	3.25	15.6	0.21	98.81	215.70

In making the corrections for soundings required from the oscillations of the river while the work was going on the gauge at Little Rock is taken as a standard, and all soundings referred to an equivalent reading for that gauge at the date they were taken, the standard reference being a middle stage of 13 feet. The difference in elevation for establishing the local gauges are obtained by multiplying the distance in miles from Little Rock by the slope of the river per mile.

The results of the discharge measurements vary greatly, as the observations were made at different stages of water. That taken at Little Rock shows a discharge of 110,413 cubic feet per second. It was made at a moderately high stage, the gauge-reading 18 feet on a scale of 26 feet for very high water. One taken at Station 91 gives 76,252 cubic feet per second with the gauge at 12 feet. One at Station 200 gives 36,930 cubic feet with the gauge at 7.7 feet.

At the point of separation at the White River Cut-off the discharge was only 67,539 cubic feet per second, although the gauge read 16 feet. This discrepancy is perhaps explained by the great volume of water that flows away into the bayous and marshes on either side of the river. Some even finds its way to the Mississippi through intersecting bayous in the lower part of the delta plane.

A section was taken in the main river above the cut-off, another at the head of the old channel, and another at the head of the cut-off. The volume of discharge in the two latter should equal that in the main river.

The result of the observation shows this to be the fact very nearly, and it also shows that the volume of water through the old channel was more than three times as great as that through the cut-off, the average velocity being much greater. The observations for discharge consisted in making a section of the river by careful soundings at short distances apart, the position of the boat at each sounding being located by

transit men from a measured base. Floats were then sent down in sufficient number, and at such distances apart that the average velocity of spaces included by the soundings might be obtained. The positions of the floats were fixed by the transits at the points where they crossed two ranges, between which they were timed. One of the ranges was the section sounded, the other was parallel to this, and at a distance of either 100 or 200 feet up-stream.

The data obtained in this way was platted to scale on paper ruled in squares to get the area of the irregular figure of the cross-section, and the floats located in the positions they occupied in making the section. The discharge recorded is the sum of the results given by the different velocities of the partial areas into which the section was divided. The average velocity is the total discharge divided by the total area.

These observations were always taken at places where the river was as free from eddies and cross-currents as could be found.

Discharge observations.

Station.	Standard gauge.			Area.	Average velocity, feet per second.	Average velocity, miles per hour.	Discharge, cubic feet.
	High water.	Low water.	When observations taken.				
Little Rock	26	0	18.0	26,725	4.12	2.80	110,413
91	26	0	12.0	15,518	4.91	3.34	76,252
200	26	0	7.7	14,162	2.61	1.77	36,930
309	26	0	11.0	13,550	2.73	1.86	37,115
392	26	0	8.9	12,381	2.90	1.97	35,944
Bayou Meto	26	0	12.4	6,000	1.36	92	8,168
679	26	0	16.0	22,362	2.02	2.05	67,539
Cut-off	26	0	16.0	12,425	1.06	72	13,217

When the White River is at a higher stage than we found it, its current turns back the Arkansas from the cut-off and part of its volume passes to the Mississippi through the Arkansas channel in the same manner that we found part of the Arkansas going out by the White River. The old channel is classed as unnavigable; it was therefore expected that trouble would be experienced in getting through it with the quarter-boat. It was found, however, quite free from snags, and with no serious obstructions to navigation in that stage of water. This old outlet is much narrower than the main river.

The greatest depth of water found between Little Rock and Pine Bluff was 37 feet, with the standard gauge reading 12.0 feet. Near sounding Station 232, between Pine Bluff and the Rob Roy Bridge, where the river is very wide, the lead was cast ninety-two times in a single crossing, and found an average depth of only 4½ feet; the main channel was narrow, with a depth of 20 feet, the gauge reading 10 feet. This was exceptional, as the sections were generally of a greater and more uniform depth. Below Pine Bluff a depth of 70 feet was obtained three times at Station 459, at Station 629, and at Station 714. The last mentioned is near the mouth of the cut-off at White River. The gauge stood at 16 feet when the depth was recorded.

High-water marks were noted by the levelers wherever found.

TRIBUTARIES.

The only tributaries of importance entering the Arkansas below Little Rock are the Fourche Bayou and the Bayou Meto. The latter is navigable at a moderate stage of water.

This bayou drains a large section of country, and contributes to the Arkansas an average of 5,000 cubic feet per second, being a stream of considerable volume. It is about 100 feet wide as an average, and of good channel depth as far as the sounding boat was instructed to explore. Boats ascend this stream for a distance of 75 miles, it is said, when the water is at a higher stage than we found it; there being certain bars further up-stream than we went that obstruct navigation in low water, and there also exist obstructions of snags and overhanging trees.

This stream passes through a cotton-growing country, where considerable land is under cultivation, and some cotton and cotton seed are brought out, but no statistics could be obtained as to its amount. A cut-off in the Arkansas has been made in recent years by the floods from the Bayou Meto assisting the Arkansas. This tributary

enters the Arkansas at two places, the main stream coming in near Station 601, and the other at a point 2 miles below, thus forming a large island on the left shore of the Arkansas. The main stream is 120 miles below Little Rock by the shore line. In the stage that we found it, this stream pours into the Arkansas 8,168 cubic feet per second, as ascertained by a discharge section at a point above a fork in the stream. The Fourche Bayou, entering the Arkansas below Little Rock, is not a navigable stream, and is of little importance as a tributary.

NAVIGATION.

In former tin es the transportation of freight and passengers through this State was entirely in the hands of steamboat-men, and many packets made regular trips on the river to all prominent river cities, but the rapid building of railroads has almost paralyzed this business. In the busiest cotton season there is a revival of interest and a demand for their services for a short time in handling cotton and seed from the plantations on the immediate bank of the river and bringing supplies in return. This trade, however, is spasmodic, and after the few weeks of hurry are over it dies away as quickly as it springs up. There are now no boats on the Arkansas in the direct New Orleans trade as formerly. freight sent down the river being transferred at the mouth of White River. One packet, making two trips per week, is amply sufficient to do all the business between Pine Bluff and below for the greater part of the year, and this is the portion of the river where exists the greatest demand for the services of steamboats between Pine Bluff and Little Rock there is one steamboat of about 200 tons making regular trips. These boats seem to fully meet the demands of the river trade for several months in the year; occasionally there are other boats plying in the river trade but the demand for their services as a rule is not sufficient to remunerate their owners. The railroads have so far absorbed the river business that the custom of hauling freight to them instead of waiting for a steamboat is growing in favor on certain portions of the river where the railroad is convenient. This is true of the south side of the river as far down as Douglas, while on the opposite side there is being built a narrow-gauge railroad near the river bank, expressly to accommodate the planters' trade; but it is very probable that the cotton grown very near the river will always be handled by the steamboats. When more land is cleared up in the lower part of the river, and the cotton fields extended, there will be new life in the river trade, for the reason that steamboats can better manage the supplies necessary for plantation use than a railroad, and can accommodate themselves to the convenience of the planters in moving stock and bulky freight, and in making landings in times of flood better than is possible for a railroad to do. It is very certain that there will always be a demand for river transportation to some degree, not as in times past when there was no other outlet and there was not the demand for quick transportation that exists to-day; but this fine water-way is so closely connected with the planting interest of the cotton growing section of the State that the boats will always be run for that special trade, regardless of the demands of the great business centers already in existence or that may spring up, and whose needs are better served by the railroads. The navigation of the river is made very safe by the work of the snag-boats that patrol the stream at proper seasons and remove all obstructions in the form of snags or overhanging trees from the channel. The average channel depth in a middle stage of water is about 20 feet. The direction of the channel is more or less disturbed by every rise, like all streams that carry a large amount of sediment in suspension, in some places remaining stable for several seasons, in others constantly shifting. The bed being generally of the same material as the banks, is worn in the same proportion. The Arkansas is navigable at all seasons as far as Pine Blurff, but there are times when it is difficult and even impossible to ascend further on account of very low water.

TOWNS.

The only city on the river below Little Rock is Pine Bluff, a place of about 8,000 inhabitants. It is the center of large commercial interests, and much business is transacted there.

Steamer landings are found at frequent intervals on the river with names that appear on the maps, but they are only the nucleus of towns, some not having a store-house, others with a store-house, a few scattered cottages, and a traveling store stocked with a general assortment of goods. A few like Red Bluff, Pastoria, Douglas, Red Fork, and Arkansas Post have more of the elements of towns, and are villages of good size with facilities for transacting the business demanded by the settlers who cultivate the land in their neighborhood.

The landings are the delivering points for the crop raised in a district surrounding it and within easy hauling distance. It is to lessen the labor of delivering the produce from the plantations that multiplies the number of landings on the river, many

plantations having a landing-place of their own. This is very easy for there are few places that a boat cannot make a good landing somewhere within a mile. The distances between the principal landings have been much exaggerated by the steamer schedule. It is said that the distances were obtained by running a steamer over a measured course and noting the time. This served as a standard to measure the river. It would answer the purpose if the current were uniform, and the speed of the boat without variation throughout the entire distance. Neither of these conditions prevails however, and the distances in consequence set down as much greater than they are in fact. It is possible also that there may have been a time when there were fewer cut-offs, the river being in a series of round bends and elliptic-shaped loops, the distances from point to point by the river would be much greater than after a few cut-offs had been made. It is well known that a cut-off of a few thousand feet in length can make the main river current shorter by several miles. The length of the river might in this way vary considerably in a few years, but not enough by natural causes to account for the great discrepancy between the measured distance which is 176 miles, and that adopted by the steamer schedule 280 miles, which is accepted as correct by the residents along the river. The distances from Little Rock to the principal landings are given in the accompanying table.

THE CHARTS.

The charts will be 21 in number when completed, showing the river from Big Rock 3 miles above Little Rock, to the Mississippi.

The scale $\frac{1}{7200}$ was adopted in order to show clearly the location of shoals and bars. A reduced copy on scale of $\frac{1}{63360}$ will be made of these charts.

Very respectfully, your obedient servant,

CHARLES E. TAFT,
Assistant Engineer.

Capt. H. S. TABER,
Corps of Engineers, U. S. A.

V 14.

CONTINUATION OF SURVEY OF ARKANSAS RIVER FROM WICHITA, KANSAS, TO FORT GIBSON, INDIAN TERRITORY.

The field work of this survey was completed in July, 1884, and the notes plotted to a certain extent immediately after. It became evident that the money allotted would not satisfactorily plot the notes, and work was suspended until such time as, by personal attention or otherwise, they could be put in available shape. This step was taken the more willingly as the assistant's report showed so little water above Fort Gibson, with numerous dams, &c., above Arkansas City, that it seemed likely no improvement would be recommended. During the latter part of the fiscal year, a steel steamer with a fleet of five steel barges, none drawing over 12 inches of water, has been put on the river from Arkansas City to Fort Gibson. This changes the whole face of the problem, and I am now securing all the data possible bearing on this new departure. To report fully and submit proper estimates I wish to see the boat visit the southern section of Kansas and secure other data. I believe this boat is designed to produce a revolution in the matter of navigating upper reaches of shallow rivers. An enormous commerce waits this southern outlet. The notes will be worked up as far as necessary, and a full report with plans and estimates will be submitted in time for the action of the next Congress.

Money statement.

July 1, 1884, amount available	$2,754 56
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	2,575 43
July 1, 1885, amount available	179 13

Amount (estimated) required for completion of existing project	$1 500 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	1,500 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

EXPENSE ACCOUNT.

Pay-rolls, labor, &c	$2,358 16
Subsistence supplies	136 50
Stationery	17 72
Traveling expenses	29 05
General supplies	33 75
	2,575 43

V 15.

EXAMINATION OF LITTLE RED RIVER, ARKANSAS.

UNITED STATES ENGINEER OFFICE,
Little Rock, Ark., December 3, 1884.

GENERAL: In pursuance with the requirements of your letter of July 31, 1884, I have the honor to furnish the following information relative to the question whether or not the Little Red River is "worthy of improvement."

* * * * * * *

From report of Assistant Engineer M. A. Orlopp, herewith, it appears that—

1st. Judsonia is the highest point warranting plans of improvement for low-water navigation.

2d. For rafting a very trifling expenditure will greatly benefit the stream for the entire distance over which this industry is carried on.

3d. The commerce to be benefited is unusually large, this stream being located in a very prosperous section of the State.

4th. His report gives all the data necessary to make an enlightened estimate of the amount required, without further survey.

5th. The present commerce from his report amounts to about 13,500 bales of cotton yearly, and merchandise imported 4,700 tons.

* * * * * * *

Future commerce is hard to estimate, but this section is regarded as one of the most promising ones in the State. Its reputation as a fruit-growing country is growing very fast.

6th. The problem of improvement is very simple and admits of a certain solution, and may be briefly summed as follows:

1. Remove the bowlders that interfere with rafting above Judsonia.

2. Remove the shoals 3 miles below Judsonia that interfere with low-water navigation to Judsonia.

The assistant's report will be found appended and marked A.

* * * * * * *

From the data submitted herewith it is recommended that $8,400 be expended upon this stream, substantially as follows:

Removing bowlders above Judsonnia	$400
Cutting channel 3 feet deep through the shoals 3 miles below Judsonia	8,000

Further remark seems unnecessary, as this case is such a simple one, and the benefits to be derived so large compared with the outlay.

* * * * * * *

I am, general, very respectfully, your obedient servant,

H. S. TABER,
Captain of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

REPORT OF MR. M. A. ORLOPP, JR., ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Little Rock, Ark., November 13, 1884.

CAPTAIN: I have the honor to submit the following report of the examination of the Little Red River of Arkansas.

* * * * * * * * *

The Little Red River, rising in the Boston Mountains, flows in a southeasterly direction and empties its waters into the White River.

At Judsonia the river enters its delta, and in its course from this point to its mouth it is a stream of very uniform width inclosed within permanent banks, which are inclined at an angle of 30 degrees from the perpendicular, and gradually decrease in height as they near the mouth.

It is a very winding stream, consisting of a series of loop-like bends, which are of great curvature and very short, and in many places it is necessary for steamboats to stop and back in order to round the points.

With the exception of one shoal between Judsonia and the mouth of the river, the depth of water is sufficient to allow steamers of 4 feet draught to navigate the waters a distance of 22 miles.

The width of the river at Judsonia is 300 feet, and gradually widens in its course to the White River, where it has a width of 400 feet.

Between Judsonia and its mouth the river may be divided into a lake and a bay. The lake commencing at Judsonia Shoals, on the western limit of the town of Judsonia, has a length of 3 miles, being separated from the bay by Bess Shoals, which take their name from the farm on the left bank. The depth of water varies from 5 to 12 feet.

The river between the Bess Shoals and the mouth of the river is a bay formed by the water from White River, the oscillation of which affects the oscillation in this bay, and as the White River remains navigable the year round it furnishes enough water for navigation in Little Red River for a distance of 22 miles, at which point the bed of Little Red River has a greater elevation than the bed of White River.

The depth of this bay, averaging about 7 feet, varies from 5 feet to 20 feet. In this bay, as in the lake, there is no perceptible current.

Proceeding up the stream from Judsonia, I found that the river was a series of lakes, so formed by the ridges which extend out from the mountains. In some instances the water has run around the foot of these ridges, forming shoals of loose stone, while in some places it has cut its way through, leaving shoals of solid stone.

The first lake is enclosed by the Judsonia Shoals and Eden Shoals.

This lake is one-half mile long, with an average width of 275 feet, and containing water, which has no current, varying from 3 to 8 feet in depth.

The second lake is included between Eden Shoals and Bond Shoals, which gives it a length of 2½ miles, and its average width being 200 feet, with a depth of water averaging 4 feet, and containing no current.

The third lake, commencing with Bond Shoals, has its head at Bealer's Shoals, which is situated immediately below Searcy Landing. Its length is about 2½ miles, averaging in width about 200 feet, with an average depth of 3½ feet. From this lake the river retains a width of 175 feet to its headwaters.

From Searcy Landing to Kilcher's Shoals, a distance of 5½ miles, the river is divided up into a number of very short lakes, which are formed by the numerous strata of stone. At Kilcher's Shoals the river has its last great fall, which is 5 feet, and this point may be considered as the point where the river leaves the mountains and enters the bottoms. Five miles above these last shoals the fall of the river, as determined by a surveying party in the employ of a company of gentlemen who were designs of building mill-power in the country, was 16 feet in 1 mile.

At Judsonia the banks have a height of 18 feet, which decrease gradually to a height of 12 feet at the mouth, and increase as you proceed up the stream to a height of 25 feet.

From Judsonia to Kilcher's Shoals the banks, instead of increasing in height uniformly, as below, have a very irregular profile, which is due to the numerous ridges.

The banks are permanent, being formed of clay with sandstone as the subsoil, and are covered with very thick brush and small timber, affording it a protection which perfectly withstands the action of the current.

Being inclined at an angle of 30 degrees from the perpendicular, and as there is no heavy timber immediately on the edge of the bank, the timber that falls does not obstruct the navigation.

At three places below Judsonia the bank has slid into the river, carrying and preserving the trees in the same position. This has been caused by the springs at these places, which have washed away the foundation or subsoil, depriving the banks of their support.

These slides are so small as not to obstruct the navigation.

From Judsonia to the mouth of the river the bed. with the exception of the Bess Shoals, is of sand and mud, while the bottom of the river from Judsonia to Searcy Landing is composed of clay and stone. From Searcy Landing to the headwaters the bed is almost exclusively of rock.

The sandy bottom does not wash out or accumulate in places, as the bed is shaped like a basin, having its greatest depth at the head of the bay, thus allowing no undercurrents to exist.

Owing to the great depth of water, the drift which is carried out by the high water cannot strike the bed, and therefore the river is altogether free from snags and drift.

There being no caving banks or leaning timber below Judsonia, this part of the river carries no drift in low water.

Above Judsonia some leaning timber was seen which falls into the river, forming snags and drift, but not to such an extent as to necessitate removing to warrant safe navigation.

SHOALS.

The only obstruction to low-water navigation to Judsonia are the Bess Shoals. These are situated 3 miles below Judsonia, and are of loose stone and sand. They are a quarter of a mile in length, consisting of 400 feet of loose stone, upon which the water has a depth varying from 2 to 3 feet. This stone is at the head of the shoal, and on the last 20 feet of stone the water barely trickles over.

The sandy bottom of the shoal extends down the river about 900 feet, the water on which varies from 2 to 4 feet.

The shoal is terminated by a line of stone extending across the river, which is 25 feet wide, and containing a depth of water of about 3 feet.

The fall of this shoal is 2 feet, and should it be cut out the water in the lake above would not be lowered sufficiently to prevent navigation.

The Judsonia Shoals, which are situated immediately above Judsonia, have a fall of 2 feet.

They have a length of one-quarter of a mile, and a depth of 1 foot, the water being barely forced over the rocks a distance of 200 feet. They are composed of large, loose sandstone, and to improve the low-water navigation above them it would be necessary to construct a dam and locks on these shoals.

Eden Shoals, situated one-half a mile above Judsonia Shoals, are of solid rock.

They slope in both directions from the middle 150 feet, having a depth on the middle of three-tenths of a foot.

Bond's Shoals, composed of loose stone, have a length of 400 feet and an average depth of six-tenths of a foot. The fall is about 2 feet.

Beeler's Shoals, which are situated at Searcy Landing, are 300 feet in length, varying in depth from 1 to 2 feet, and having a fall of 1½ feet.

Above the shoals the river has a small current and retains it until the headwaters, there being no large pools of any note.

From Searcy Landing to Kilcher's Shoals the bed of the river may be called one long shoal, the water in many places barely moistening the stones.

Large stones exist in the stream above Kilcher's Shoals, which make the navigation dangerous at a very high stage.

FLOODS.

As the country along the stream is being cleared for farming purposes, and as the timber is being cut near its headwaters, all of the rain that falls in the wet season is allowed to flow into the river at once, the result of which is that the river, being not of sufficient depth and breadth to accommodate this volume of water, overflows the surrounding country to a depth of from 2 to 5 feet.

This overflow depends a great deal upon the stage of water in White River. Should White River be low at the time of the rise in Little Red River, the country is not overflowed to such a great depth, and the duration of the flood is very short. While, should White River be swollen, the reverse is experienced.

The floods generally occur about the latter part of January, the water remaining at its highest stage for five or six days, when it recedes to a height of 6 or 8 feet above low-water, at which stage it remains until the middle of June.

From June to September the low water is experienced.

From September until the floods slight rises occur, which do not increase the depth sufficiently to insure navigation above Judsonia.

Lumbermen take advantage of the highest stage of the water to float their timber to the markets.

Rafting is always attended with great danger until Searcy Landing is reached.

The greatest oscillation at Searcy Landing has been 28 feet and 20 feet at Judsonia, while at the mouth of the river the water has never risen more than 18 feet above low water. This decrease in the oscillation is owing to the river overflowing its banks and inundating the country.

At high water the current has a velocity varying from 3 to 6 miles per hour, owing to the condition of White River.

Below Judsonia the country is a flat alluvial bottom, the elevation of which is less than the elevation of the banks of the stream.

As this river contains no tributaries, the water which overflows the banks is only drained from the country by bayous, which it has formed since 1872, there being no floods previous to that year.

From the headwaters to within 5 miles of the White River the country is well settled up, the people being engaged in farming and cattle raising. The soil is very rich in the bottom, receiving each year a new deposit of sediment from the overflow. The bottoms abound in cane, which act as winter pastures for cattle, and were it not for the danger of losing cattle by the high water it would be the finest pasture in the State.

The lumber is very fine and abounds in very large quantities, the principal of which are white oak and cypress, with cotton-wood, willows, red, post, and water oaks, hackberry, ash, and some walnut; the mountains and ridges are covered with a fine growth of yellow pine.

Five miles north of Judsonia large quarries of very fine white sandstone exist.

The country above Judsonia consists of ridges with swamps bordering along the river.

The uplands, while not as rich as the bottom lands, are very thickly settled with farmers, who devote almost all of their land to fruit and vegetables.

The stone in the ridges is principally sandstone, with some veined granite, the quality of which is very poor.

Three towns are situated on the stream, the largest of which is Searcy, which has a population of 2,000. It is situated about 2 miles south of the river, and ships yearly from 6,000 to 8,000 bales of cotton, and also a large amount of fruit, of which an estimate could not be obtained.

Corn is raised only to supply the demand of the people in the country. It receives imports which amount yearly to 4,000 tons.

A very large number of fine sulphur springs exist in the town, and they are claimed to possess medicinal properties. Large numbers of people from the State flock here to partake of the health-giving waters.

Judsonia, which is situated 22 miles from the mouth, on the Saint Louis, Iron Mountain and Southern Railway, contains a population of 400 souls.

It ships yearly from 1,000 to 1,500 bales of cotton and receives 400 tons of imported merchandise.

This town also contains a saw-mill, tannery, and cotton-mills.

The Saint Louis, Iron Mountain and Southern Railway crosses the river upon an iron Howe truss bridge of two spans.

The piers are of stone, built upon a foundation made by throwing stone into sheet piling. The "false works" which were used to construct this bridge still remain in the channel and are an obstruction to navigation.

The draw-span consists of 19 panels 15 feet in length and 20 feet high.

The other span consists of 8 panels of 15 feet in length and the same height of the panels in the draw-span.

The bridge has no approaches, the spans resting on abutments and the ground filled in from them. The total length of the bridge is 405 feet.

West Point is a small village situated on the right bank 5 miles below Judsonia. Its principal export is cotton, of which commodity it ships about 4,000 bales yearly, 2,500 of which it receives from Searcy by a tramway which connects these two towns. This tramway crosses the railway at Kensett, the shipping point of Searcy.

The Chickasaw, a Memphis packet, drawing 3½ feet, makes regular weekly trips to West Point, and brings to this port about 300 tons of merchandise per annum.

IMPROVEMENTS.

In order to require navigation to be made possible at low water, it would necessitate the building of a dam and lock upon Judsonia Shoal. The dam would require a height of 6 or 7 feet to give Searcy Landing 3 feet of water.

The expense which this would demand would be too great for the amount of commerce which this country possesses.

As it would not require the expenditure of a very large amount of money in order to make navigation possible at low water as far as Judsonia, and from which benefit would be derived, the estimate given is only for the cutting out of the Bess Shoals, which will allow navigation during the year for a distance of 22 miles.

Should the river be opened to this point, 75 per cent. of the cotton, which is the chief export of the country, would be shipped by water to Memphis or New Orleans, which are better markets for this produce than Saint Louis.

As the Bess Shoals contain only 300 feet of loose stone and about 1,000 feet of sand, a dredge of a capacity of 1 yard would easily cut this shoal out in the course of two months.

The earth excavated would have to be placed upon barges and thrown in deep water, which exists immediately below this shoal. The following is the estimate for this improvement:

1 dredge-boat	$4,000
2 barges, at $1,000	2,000
1 foreman in charge, at $125	250
1 engineer, at $100	200
20 laborers, at $35	1,400
Subsistence at 50 cents per day	330
Total	8,180
Contingencies, 10 per cent	818
Grand total	8,998

THE RIVER ABOVE KILCHER'S SHOALS.

From the headwaters of the river to Searcy Landing the river runs through a country of very mountainous character. The river in its course has cut through many ridges, leaving perpendicular bluffs of solid stone having an elevation of 150 feet, while in other places the river has run around the end of ridges, leaving a high bank only on one side.

The land which is adapted for farming purposes, being in the valley and along the bank of the river, is very rich, but of limited dimensions.

The banks of the river vary in height from 20 to 30 feet, which is sufficient to prevent any overflow in the wet season.

The river being a very winding stream encounters different soil, which, when of rock, does not allow the water to cut into its banks, while in other places the river, running through a loamy soil, which has little protection, has cut into the banks, causing the bed to widen. The width of the stream varies from 150 to 300 feet.

The depth of river varies from 3 inches to 3 feet, in many places the water being forced over the bed, and with the exception of three lakes, in which the water has a depth of 5 feet, the river resembles a large mountain creek.

The current varies greatly in velocity, being sometimes imperceptible and often attains a velocity of 2 miles per hour.

The principal products of the country are cotton and corn, with some fruit, the value of which is very small as compared with the value of the pine and oak timber, which exist in remarkably large quantities and of a very superior quality.

Pine and oak trees were seen which have a diameter of 4 and 5 feet, varying in height from 75 to 125 feet.

A great number of people are engaged principally in rafting this timber to the markets, while others are engaged in getting out staves, which are floated out in barges which are cut up on arriving at their destination and sold as lumber. The amount of timber and staves thus floated out in high water is very large, and would be much larger should three obstructions be removed which have caused the destruction of many rafts of timber.

It was impossible to obtain a correct estimate of the amount of timber which has been rafted, but it is evident that the quantity of timber in these vast forests is sufficient to warrant the expenditure of a small amount of money for the removing of these obstructions which prove very dangerous to the navigation of rafts.

OBSTRUCTIONS TO RAFTING.

Fifteen miles from Searcy Landing the first obstruction was noticed. This is a very large sand rock, which is called "Ten Mile Rock," owing to its proximity to a creek of that name.

It is situated on the left side of the channel, into which it has fallen from a high rock bluff on the left bank, and its general shape being that of a frustum of a rectangular pyramid. The dimensions of the stone are: Altitude, 15 feet; bases, 12 and 6 feet. Its volume is 45 cubic yards.

The second obstruction is situated 5 miles above Ten Mile Rock, and is known to raftsmen as "Old Sow," from the appearance which it presents from up the river.

It is a frustum of a cone, a section of which is an ellipse, the radii of the upper face being 4 and 2 feet, while those of the lower face are 6 and 3 feet. Its altitude is 14 feet, which gives it a volume of 50 cubic yards.

It is situated in the middle of the stream, which is 300 feet wide at this point.

The third rock is about 45 miles above Searcy Landing, and is also known as "Old Sow." It is in the middle of the stream, the width of which is 250 feet, the banks of the river being low.

The stone is a sand rock, the general shape being a fustum of a cone. The faces are ellipses, the radii of which are 5 and 3 feet for the upper face and 8 and 4 feet for the lower face. The altitude is 15 feet and the volume is 95 cubic yards.

To make rafting safe it is only necessary to destroy this rock by blasting and leave the rock thus disintegrated in the bed of the river.

The amount of stone thus requiring destruction is 190 cubic yards, which, taking the smallest quantity of solid rock removed by 1 pound of powder, would require 100 pounds of powder or 10 pounds of dynamite.

The river could be cleared of these obstructions in one month by employing a foreman and four men.

The following is the estimate of the amount of money it would require to make rafting less dangerous for a distance of 50 miles above Searcy Landing to the mouth of the river:

1 foreman in charge	$75 00
4 laborers, at $40	160 00
Subsistence, 5 men, at $15	75 00
Drills and tools	50 00
Explosives	5 00
Total	365 00
Contingencies, 10 per cent	36 50
Grand total	401 50

Very respectfully, your obedient servant,

M. A. ORLOPP, JR.,
Assistant Engineer.

Capt. H. S. TABER,
Corps of Engineers, U. S. A.

V 16.

EXAMINATION OF RED RIVER ABOVE FULTON, ARKANSAS.

UNITED STATES ENGINEER OFFICE,
Little Rock, Ark., November 12, 1884.

GENERAL: In pursuance with the requirements of your letter of July 31, 1884, I have the honor to furnish the following information relative to the question whether or not the Red River above Fulton is "worthy of improvement:"

* * * * * * *

From the assistant's report it appears that—

1. There is no demand for low-water navigation, there being nothing to transport at that season.

2. The amount of commerce warrants a certain outlay.

3. This outlay will be of most practical benefit if made to secure safer high-water navigation.

4. Its similarity to other rivers in this district permits a practical solution of its improvement with the above facts established; *i. e.*, the application of snagging appliances to the removal of snags and drifts.

5. No further survey will be required to prepare plans and estimates for the improvement of this river.

6. Present commerce, 20,000 bales cotton, 2,500 tons merchandise; future commerce is likely to exceed the present.

The assistant's report will be found appended and marked A.

RECOMMENDATIONS AND REMARKS.

The proper outfit for this work is a hand snag-boat, costing about $4,000. It will cost about $1,500 per month for running expenses. Four months' work ought to put the stream in fair shape at a total cost of $10,000; therefore, this reach of river can be put in serviceable condition during high and medium stages of water.

Should the commerce of the river ever warrant further or more permanent improvement, the improvements suggested here would be the natural stepping stones to such improvement; and while the improvements recommended are going on data can be collected without much expense upon which to base plans and estimates for such additional improvement.

In conclusion it may be stated that while it would have been more satisfactory to have carried the examinations still higher up the stream, yet, so long as the money allotted did not permit, it seems best now to leave this until such time as it may be done more economically; when the improvements have advanced as far as the river has been examined. Reliable authority gives the stream the same general character for many miles further, so that so long as the outfit proposed would answer every purpose for this long reach of river, it seems poor economy to devote any more money at present to preliminary examinations or surveys.

* * * * * * *

I am, general, very respectfully, your obedient servant,

H. S. TABER,
Captain of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

A.—REPORT OF MR. M. A. ORLOPP, JR., ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Little Rock, Ark., November 3, 1884.

CAPTAIN: I have the honor to submit herewith a report of the examination of Red River from Fulton, Ark., to a point 150 miles above.

In obedience to your letter of instructions of the 21st of October, 1884, I proceeded to Fulton, Ark., arriving there in the evening of the 21st, and the next morning at half-past 8 started up-stream.

Comparing the river with the tracing which I took from the map in the office, I found the map very correct for a distance of 80 miles; when, after reaching this point, there was no similarity existing between the river and the tracing.

As the river above this point could not be made navigable without the expenditure of a large amount of money, and as the commerce of the country does not demand this improvement, I did not think it was necessary to obtain sufficient data for plotting the river.

On Monday, the 27th of October, the river rose 7 feet, which caused such an increment in the velocity of the current as to greatly retard my progress. Had it not been for this rise I would have succeeded in ascending the river as far as Colbert's Station, where the Missouri, Kansas and Texas Railway crosses the river.

Notwithstanding this rise, I reached that point where all improvement necessary to make navigation possible at low water ceases to be practicable.

Proceeding up-stream from Fulton, Ark., soundings were taken every 300 feet in the channel, and every 100 feet on the crossings, where it was evident that the water was shoaling.

On the shoals two diagonal lines of soundings were run.

The character of the bottom and the nature of the soil was observed, which remained the same throughout the course of the river.

Distances were estimated by calculating the run of the boat in a certain time, from observations taken for a short period of time.

Owing to the late start of Thursday, the 23d instant, I succeeded in making only 18 miles.

On Friday, the 24th, I made 25 miles, passing the Texas State line about half past 10 o'clock in the morning. On Saturday, the 25th, it was necessary to quit work early on account of threatening rain, and therefore only 21 miles were made.

On Monday, the 27th, about 8 o'clock I passed the Indian Territory line, and camped a distance of 20 miles above the line. During this night the river rose and the current being increased, the distances made from this on were not so great as on the first days of the examination. About 2 o'clock of this day I passed that point where there was no comparison to be made between the map and the river.

Tuesday, the 28th, I succeeded in reaching a point 20 miles above my last camp.

Wednesday, the 29th, 20 miles were made, passing Walnut Grove at 12 o'clock.

On Thursday, the 30th, at 12 o'clock, I reached a point which was situated about 12 miles below the Kemishi River, and owing to the state of the expenses for the trip I commenced my trip down the river, checking over the distances which I had estimated on my journey up the stream.

As the people in the country were in arms for the purpose of hunting the perpetrator of a crime in Little River County, Arkansas, I did not deem it safe to camp in the country, and therefore I continued my journey during the night, arriving at Fulton, Ark., at daybreak, on Saturday, November 1.

The river is a very narrow and winding stream, consisting of a series of very short reversed curves of great curvature with very short crossings. The water in passing from one side to the other frequently runs at right angles to the channel in the preceding bend.

According to the shape of the bed the water is crowded over to the outer bank of a bend, where all of its available force is concentrated, thus allowing it to expend all of its energy on a portion of the bed, which it has washed out so effectively as to make the depth of water sufficient to float very large boats.

The earth thus washed out of the bends, instead of being carried away by the water, is only held in suspension until the water crosses from one bend to the other, where, on account of the widening of the bed, the channel is not confined, which allows the water to be distributed over the crossing, lessening the velocity of the water and allowing deposition of the sediment, which is greatly aided by the snags and drift which have lodged in the head of the crossing.

The water by being resisted when it reaches the crossing is deflected to the inner bank, where it forms an eddy, which allows of a quick deposition of the sediment, and as high water is of long duration these bars are very large, extending to within 500 and 600 feet of the outer bank in low water.

These bars, instead of being flat, are high at the bank, and sloping gradually to the water's edge. The head of the bars are always being cut at low water, but as the bends are of such great curvature the bars never cave beyond a tangent to the outer bank of the upper bend.

In the bends the water has an average depth of 4 feet, while the channel varies in width from 100 to 150 feet. On the crossings, where, on account of widening of the water, the depth is decreased and varies in different crossings 1½ to 2 feet.

At a point 50 miles above Fulton, Ark., the width between banks gradually increases, and as it carries the same amount of water as below, there being no tributaries of any importance above Little River until Kimishi River is reached, the depth decreases so as to make navigation at low water for boats drawing more than 1½ feet impossible.

The upper river, unlike the lower, consists of long bends with small curvature, and many long reaches in which the channel is often divided, allowing the sediment to be deposited between channels and forming many island sand-bars.

Throughout its whole course the banks retain a height of 15 feet above low water. The bank on the inner bend is sloping and decreasing to a height of 12 feet. The outer banks of the bends are always caving or sliding.

In almost all of these outer bends the land has been cleared for farming purposes and as all of the timber has been cut these banks are deprived of the protection afforded by the timber and underbrush, allowing the current to act without any resistance, the result of which is that all of these places are caving very badly. In a few bends, where the timber and brush have not been removed, the banks withstand the force of the current to a better advantage.

In three places it was noticed where the banks had fallen bodily into the water, carrying and preserving the timber in its same relative position. Where these slides have occurred at the head of a bend it has been the means of preserving that part of the bank below it, acting as a dike to change the direction of the current.

These slides are due to the soil being of clay and the subsoil a sandy loam; the latter being washed out, depriving the soil from any support, it naturally slides.

The character of the surrounding country shows how susceptible the banks are to the action of the current.

On both sides of the river and along its whole course there are continuous chains of lakes which are formed by the vibration of the bed of the river.

These lakes are from one-half to 2 miles inland, and, from the similarity existing between their banks and the banks of the river it is very evident that at one time they formed a part of the bed of the river. They vary in depth from 8 to 15 feet, and in length from one-half to 2 miles, and prove to be of great advantage to the country and to navigation, as they serve as large depositories for the water in the flood season when the river overflows its banks, thus preventing inundation and prolonging navigation by acting in the capacity of feeders, being connected with the river by bayous.

At Walnut Bayou, 25 miles above Fulton, Ark., the river at one time formed a large double horse-shoe curve, shaped like the letter S, the water cutting through at the narrowest point, leaving a lake on each side. This place is known to steamboat men as "Figure Eight Cut-off."

In many places where trees and drift have lodged on the banks they have been the means of aiding and quickening the deposition of the sediment so as not only to act as a protection, but being the means of covering the banks with a thick coating of red clay, which the river gathers in its flow through the red lands near its headwaters.

Could the banks be protected while the river is in its present condition of short, sharp bends, and the snags and drift be removed from the crossings, navigation would be assured for boats of not more than 2½ feet draught during the year for a distance of 40 or 50 miles above Fulton.

Judging from the velocity of the current and the depth of the water, the bed of the river has a fall greater than ordinary.

The bed is composed principally of sand and clay, with very little gravel, and in one place rock was found for a distance of 400 feet.

The drift which the water gathers during the flood season, and the timber which falls in with the caving banks, gradually accumulates on the crossings, where the water is not of sufficient depth to allow it to float off, thus forming permeable dams which is the main cause of the existence of such shoal water.

Owing to the depth of the water in the bends, very little drift is found in these parts, and where it has lodged the direction of the current has deposited them very close to the bank, making drift and snags deposited in the bends advantageous instead of detrimental to navigation.

Owing to the form of the banks of the lower part of the river, the water is so confined as to prevent the bed of the river appearing above the surface as sand-bars.

Only four sand-bars were observed in the river, which were entirely due to the amount of drift and snags at the head of the crossings.

The upper part of the river differs from the lower in this respect: The bars are numerous and are not the result of the accumulation of snags and rock-heaps, but are caused by the courses of the river.

SHOALS.

Where the water crosses from one bank to the other the bed of the river has been raised by the sediment; therefore all these places may be classed as shoals. These places would not require the building of dikes and dams for the purpose of confining the water so as to afford sufficient depth, as the water has such force and direction to prevent it from spreading while crossing should these crossings be cleared of drift. With the exception of these crossings only three shoals were observed.

White Oak Shoals, situated 15 miles above Fulton, are of rock, extending diagonally across the river for a distance of 400 feet. The average depth-water in the channel, which has a width of 150 feet, is about 2 feet.

Cottonwood Shoals are situated 2 miles above White Oak Shoals. The bottom is of sand. The average depth of water is 1½ feet, with a channel of 200 feet. They extend down the river a distance of 800 feet, but are not continuous, breaking off twice into deep water.

At Walnut Bayou, or "Figure Eight Cut-off," a large bar has been formed in the middle of the river by the action of the two currents from the river and the bayou.

The main body of water passes to the right of the bar and has a channel 150 feet wide, in which the average depth of water is 1½ feet.

This shoal is of sand and has a length of 1,000 feet.

The valley of the Red River varies in width from 5 to 10 miles. Its soil is of a very rich sandy and clayey loam, well adapted to the raising of cotton, corn, and cattle, which are its chief products

Owing to its moist character the produce is not affected by drought when the soil is properly tilled.

This year, while the people in the other parts of the State have had their crops affected by a very severe drought, the farmers on Red River have not felt any severe effects from the very long dry season.

Nearly one-fourth of all the available farming land has been cleared and is worked by negroes who pay rent by receiving a certain percentage of the produce, the remainder being the share of the owner.

Stone is not found in the valley, and on the hills that which does exist is of such poor quality as not to justify quarrying.

The timber in the valley is chiefly of cottonwood and ash, with now and then cedar-brakes and bois d'arc thickets. Almost all of the walnut has been cut out, while the cedar and bois d'arc are so small as not to be valuable. The hills are covered with fine qualities of the different oaks and yellow pine.

The country abounds in game of all kinds, while the lakes contain large and fine quantities of fish, which are now attracting the attention of the Fish Commissioners.

The river also contains a great many fish and beavers. Fishermen and trappers are settling along the river, being attracted by the great number of fish and beavers that live in these waters.

The produce raised in the valley of the Red River, from the line dividing the Indian Territory from Arkansas to Fulton, is estimated at 25,000 bales of cotton and 500,000 bushels of corn.

The only means of shipping this produce to markets is by the Transcontinental Railway, which is on the south side of the valley, its nearest point to the river being 9 miles distant. Two small boats run up the river from Fulton, but as their trips are uncertain the farmers cannot always depend upon them. They are therefore compelled to haul their produce to market by wagons in dry weather, and in wet weather they are compelled to await the coming of a boat.

Two railroads have been projected to cross the valley from north to south. One line crosses the valley about 10 miles above Fulton and the other about 60 miles above the same town.

Richmond, a small town of a population not exceeding 100, is situated 10 miles above Fulton and 6 miles north of the river. It ships yearly about 4,000 or 5,000 bales of cotton, and the tonnage of merchandise annually imported will amount to 500 tons.

Fulton has a population of 350 souls. Merchandise to the amount of 2,000 tons is yearly imported to this town, and it is estimated as handling 15,000 bales of cotton per year.

This town is situated on the Saint Louis, Iron Mountain and Southern Railway, which crosses Red River at this point on a magnificent iron bridge of the Howe truss patent.

The structures for this bridge are made by driving sheet-piling and filling in with "pierre perdue."

The substructure is of masonry, while the superstructure is entirely of iron.

The bridge has three piers and two abutments. It is 792 feet long, consisting of four spans of the following dimensions:

Two spans, 90 feet in length, each containing 6 panels 15 feet long each.

One span of 20 panels 20 feet long.

One draw span 312 feet in length, containing 17 panels.

Between the first and second piers of this bridge a sand-bar has been formed, which catches the drift, causing the bar to build up with every high water.

Between the second pier and the draw pier all the drift which the river carries must pass, and as this space is not wide enough to allow the drift to float freely by it is backed up for a distance of a quarter of a mile.

Five or six years ago the old bridge, which stood about 20 feet above the present one, was washed away by the drift, and to protect this iron bridge a locomotive is employed during high water to pull the drift when it blocks up the river.

TRIBUTARIES.

With the exception of Little River, the feeders of the Red River carry very little water. Little River empties its water into the Red River 2 miles above Fulton.

It is about 250 feet wide, and is navigable for a distance of 40 miles for boats drawing not more than 3 feet.

Its banks are covered with a thick growth of timber and brush, which protection is sufficient to prevent washing and caving.

The valley is well settled up, and large quantities of walnut and yellow-pine trees are rafted out to the mills at Fulton.

The Kimishi, Clear, Boggy, Blue, and Washita empty their waters into the Red River far up near the headwaters.

These streams are nearly of the same size, having a depth at their mouths of about 3 feet, and in high water can be navigated for 12 or 15 miles.

FLOODS.

The flood season, commencing about the middle of January, ceases about the first part of February.

In January the river, on account of the great rainfall in the valley, which was 40 inches last year, overflows its banks along its whole course. This water inundates the country and remains on the surface for two or three days. The water is backed up from a half mile to 2 miles, according to the character of the ground.

The water gradually recedes to a height of 6 or 8 feet above low water, where, with the exception of a few oscillations, it remains until the 1st of June, when it falls during the month of July to low water.

Low water exists until the 1st of November, when slight rises occur which restore navigation. The water has an oscillation at the Indian Territory line of 15 feet, which is increased to 20 feet at Fulton. This increase in the oscillation is due to the Little River and the width of the river at Fulton.

At extreme high water the current was variously estimated from 5 to 7 miles per hour.

At low water the current is imperceptible in some bends, while in others it has a velocity of 1½ miles per hour.

IMPROVEMENTS.

As the improvement of the navigation at low water would require an expenditure of money the amount of which is not warranted by the amount of commerce carried on at that time, this estimate is made only for the purpose of making navigation less dangerous at high and low water.

Steamboatmen do not care to navigate the river at low water, as there is nothing at that time of the year requiring transportation. The great number of snags in the river require them to float down with the current, using their power only to keep the boats away from snags.

Were it not for the great number of snags and the amount of drift in the crossings, the water would soon increase the depth on these crossings to allow boats of 2½ feet draught to navigate the river safely a distance of 40 or 50 miles during the year.

A small snag-boat, if properly employed during the season, could greatly benefit the navigation the above distance, and probably as far as the line of the Indian Territory and Arkansas.

With the caving banks a great deal of timber falls into the river, which lodges in the bed, forming snags and rock-heaps. This timber should be cut from the bank, and instead of cutting it up in small pieces to prevent it from lodging in the bed, it would be more beneficial and less expensive to fall it down the bank and anchor it, thus affording a natural protection to the banks.

Mattress work on the Red River would be expensive, as there are no stone or willows fit for the purpose; they would have to be imported and would command an exorbitant price.

The following is the estimate:

One snag-boat, 100 feet long	$4,000
Captain, six months, at $150	900
Pilot, six months, at $100	600
Mate, six months, at $100	600
Clerk, six months, at $75	450
First engineer, six months, at $100	600
Second engineer, six months, at $60	360
Watchman, six months, at $45	270
First cook, six months, at $40	240
Second cook, six months, at $25	150
Two waiters, six months, at $20 each	240
Ten deck hands, six months, at $30 each	1,800
Total	10,210
Contingencies, 10 per cent	1,021
Total	11,231

Very respectfully, your obedient servant,

M. A. ORLOPP, JR.

Capt. H. S. TABER,
Corps of Engineers, U. S. A.

SUPPLEMENTAL REPORT.

UNITED STATES ENGINEER OFFICE,
Little Rock, Ark., December 18, 1884.

GENERAL: Referring to my letter of November 12, 1884, I have the honor to inclose the report of an assistant sent to make a further examination of the Red River above Fulton. Taken in connection with my report as contained in that letter it sets at rest the question of the desirability of improvement above the mouth of the Kimishi River. I have no desire to modify my report, but simply forward this as a satisfactory confirmation of predictions as to what would be found. In justice to this assistant I must invite attention to the length of river examined at such a trifling expenditure of money.

I am, general, very respectfully, your obedient servant,

H. S. TABER,
Captain of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

REPORT OF MR. MAX A. ORLOPP, JR., ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Little Rock, Ark., December 4, 1884.

CAPTAIN: I have the honor to submit the following report of the examination of the Red River, from the mouth of the Little Wichita to the mouth of the Kimishi River, a distance of 150 miles, making the examination complete to Fulton, Ark., a distance of 305 miles:

In obedience to your letter of instructions of November 25, I left Little Rock at 12.30 a. m., November 26, and proceeded to Denison, Tex., which place, I learned upon inquiry, would be the most economical point from which to work.

Arriving in Denison at dusk on the 26th I started on my journey early the following morning. At this point the river was in such a bad condition that any attempt to ascend it in a skiff would be very expensive; I concluded to proceed up the river on horse-back and finish the reconnaissance by water on my return.

I proceeded up-stream on the 27th, and by night had camped in what is known as Delaware Bend, 35 miles from Denison, and on the 28th reached the mouth of the Little Wichita, 60 miles from Denison.

At this point the river was in such a condition that I did not deem it advisable to make any further examination, and so returned to a point about 1 mile below the mouth of the Wichita, where I had made arrangements with a trapper to take me to the Kimishi River. Arriving there on the morning of the 30th at 10 o'clock, I sent my horse to town and the next morning proceeded down the river, camping the first night at a place 50 miles below the railroad bridge. On the evening of December 2 I arrived at the mouth of the Kimishi River, and the next morning started for Clarksville, where I boarded the train and proceeded to Little Rock.

By this method I have made quicker time and examined more river than if I had proceeded the whole distance up-stream.

The examination thus made comprises all the main part of the river—a very long reach—any attempted improvement of which will not prove successful. I have made a rough estimate of the amount required for improvement, from the number of dikes and dams and lengths of same necessary, yet I do not believe the quicksand could be completely controlled by the best judgment, backed by this amount of finances.

From the mouth of the Kimishi River to the mouth of the Blue River, a distance of 55 miles, the width of the Red River between the banks remains the same as that part of the river below the Kimishi River. The river, instead of winding back upon itself in a series of loop-like forms like the lower river, contains long bends of little curvature, which are often connected by long straight reaches. By this form of the river the bars, which are connected to the banks, are necessarily decreased in dimensions. This is caused by the current, which, instead of being turned directly aside by the banks, acts with greater force upon the inner bank of the bends of small curvature, and the sand and earth thus washed out is distributed in the bed of the river. As the channel is not confined, the sand thus washed out, instead of being deposited

in those places where the current is very slight, and which would cause only the formation of bars connected with the banks, has, on account of the many little channels into which the main channel is divided, formed island bars, which are so numerous as to make it impossible to trace the main channel from the form of the banks. This being a quicksand, washes very rapidly, and causes the shifting of the channel to be very frequent. From information gathered from the people, places where the river was fordable have been known to wash out to deep water in one day and fill up in the same time. Where the water crosses from one side to the other, and in the reaches, the depth of water is very slight in those places which have any width, while a greater depth was often observed between bars or reefs, but of such a width as to be utterly useless for navigation.

These narrow channels are only in their primary state, having just commenced cutting through bars or reefs, and in short time will have widened the space but decreased the depth, where the water will be impeded in its course, and will therefore be turned aside, causing a repetition of the same process on the other side.

The depth of water in this reach has decreased from the mouth of Kimishi River, where the depth of water in the bends would average about 2 feet and on the crossings 1½ feet in low water, while at the mouth of Blue River the depth of water is less by 4 inches in the bends and by 6 inches on the crossings.

From Blue River to the Washita River, a distance of 55 miles, the river presents much the same appearance as that part just described, with the exception that a decrease in the curvature is noticed and the banks become of a more permanent nature, caused by the character of the country changing from a clay subsoil to rock and slate, with some evidences of lignite. In this reach the depth of water in the channel at low water will not exceed 7 feet, the quicksand in the river being to a depth of 40 feet, which depth was ascertained from the employés of the Missouri, Kansas and Texas Railroad Company, who excavated to that depth for a foundation.

After passing the Washita River the last tributary of any note is left behind and a great change is very quickly noticed in the volume of water. From the Kimishi River to the Washita River the width of the stream will average 700 feet, while 20 miles above the Washita River the width gradually decreases, and at Belknap Creek, 10 miles below the Little Wichita River, the width of the river is about 550 feet. The width of the river is ascertained from the ropes stretched across the river for the purpose of propelling ferries. In this reach, which is 40 miles in length, the banks are more permanent, and large bluffs of lime and sandstone project out to the river, which are the causes of forming a series of very large bends, but not containing that curvature necessary to confine the water sufficiently so as to make navigation possible.

The bed of the river is similar to the Upper Arkansas River, containing many island bars of different sizes, which are distributed in all parts of the bed, bearing good testimony to the shifting nature of the sand.

The reach of river thus examined, which is 150 miles in length, is very irregular in its width. At some places the banks have washed out, leaving large bays, and in many places the width of water is over 1,000 feet. By this irregular form of the banks large quantities of the earth fall into the river, which fill up the places washed out by the current. The channel being changed, the other bank is attacked, which yields readily to the current, while the sediment is being deposited on the other side in the still water. Thus the river continually vibrates in its bed, causing the formation of so many island bars. These bars would cease forming could the banks be protected so as to prevent them from furnishing the material.

From Kimishi River to Blue River the banks, with the exception of one place, are of a uniform height of 12 feet, increasing very gradually. In the outer bends very low places were frequently noticed, being caused by the wash of the surface water deposited by the heavy rains in the wet season. Fifteen miles above Kimishi River, Garrett's Bluff extends along the river about 1 mile in length and 30 feet high, and is composed chiefly of a clayey loam, with some loose stone.

After passing Blue River the country changes from a wide level bottom to one that is frequently intersected by small ridges presenting a bluff appearance at the river, many containing loose stone, while others are composed chiefly of solid strata.

Immediately on the banks the timber is not found in large quantities nor of fine quality. The growth is chiefly a few miles from the banks and principally on the small streams and bayous. Throughout its whole course the banks are caving to a very great extent, being chiefly composed of sand, with very little clay, which is deposited on the sand by the river in time of the floods. In many places the banks have received a deposit of sand which has washed up against them, forming a high and narrow bluff, thus making the main bank a reinforce. This sand bluff is not permanent, although it gathers much brush and drift, and often contains vegetation. Notwithstanding the protection thus afforded by nature and the river, the continual wash of the water gradually deposits this sand again into the bed of the river, and thus it is that the banks are continually building up in one year and being washed away in the next.

After passing Walnut Creek, a small stream 15 miles above the Washita, the banks are of a more permanent nature and do not yield so readily to the current, but the amount deposited is sufficient to keep the bed of the river continually filled with bars, and from information gathered from the natives this property is common to the river almost to its headwaters.

In this part of the country stratas of the red clay, which gives the water such a red color during the season of the floods, commence to appear, the quantity of stone increasing and the amount of timber and underbrush decreasing.

The bottom of the river is quicksand, with very little clay, and has a depth of 40 feet. The profile of the bottom is very irregular, presenting large elevations and depressions, which are distributed throughout the bed without any uniformity. This irregularity is caused by the shifting nature of the sand, which yields so readily to the current that what is to-day a depression will to-morrow be an elevation. The bed of the river has an undulatory motion, causing the water to be in large pools divided from each other by large reefs of sand.

The drift and snags in the river are very few. In this sand the great quantity of drift which is carried by the floods is very quickly held, forming snags and rack-heaps for only a short period, as they very rapidly sink in the sand.

In the excavation for the foundation of bridges opposite Denison the work was very seriously interrupted by this drift, which had sunk into the sand and was encountered for a distance of 20 feet.

The unevenness in the bed is not confined to one side of the river with deep water either in the middle or near the opposite bank, but is distributed throughout the entire width. Instead of only one deep depression throughout its course there are a number of small ones, which are not continuous, but which abut against a reef, so that, virtually, there is no channel existing in the river until the mouth of the Boggy River is reached, where the volume of water is somewhat increased, and the banks have a more winding form, thus confining the water to a better advantage.

Not the slightest trace of stone or gravel was found in the bed, except at the mouths of tributaries, where also some muddy bottom was observed.

I learned from the bridge-keeper near Denison that immediately below the bridge was a bar upon which only one month ago fishermen found 15 feet of water, which demonstrates how rapidly the material composing the bottom will fill up and wash out.

The only tributaries of any note, and which provide over 50 per cent. of the volume of water, are the Kimishi, Boggy, Blue, and Washita rivers, which all flow in from the Indian Territory, in the mountains of which they rise.

The Kimishi River which empties into the Red River 155 miles above Fulton, Ark., rises in the south central part of the Indian Territory, in the Kimishi Mountains, and is about 100 miles in length. Its width, at the mouth, is about 250 feet, having an average depth of 1½ feet at low water. The velocity of its current was estimated at 1 mile per hour. The banks are permanent, being well protected with timber. The bed of this river is composed of black clay and stone, alternating.

Twenty miles above Kimishi River the Boggy River empties its waters into the Red. This stream is almost similar to the Kimishi River in length, breadth, depth, and the nature of its banks and character of its bottom. The current noticed was not of such velocity as that in the Kimishi River. It rises in the Canadian Mountains, about 8 miles south of the Canadian River, which empties into the Arkansas.

The Blue River, situated 35 miles above the Boggy, has its source in the Canadian Mountains, and flows parallel to the Boggy River. The width at the mouth is 250 feet, with an average depth of 1½ feet. The bed is composed of stone and black clay.

One hundred and ten miles above the Kimishi River the Washita, the largest of these tributaries, enters the Red River. Its width at its mouth is 400 feet, and its average depth of soundings taken every 50 feet is at low water 2 feet. Like the other tributaries, the Washita flows through a country of loose stone and clay, and it may be said to have permanent banks and a stone bottom, which gives place to clay about 15 miles above its mouth. The river rises in the Washita Mountains in the western part of the Indian Territory, winds through a very mountainous country, and has a length of over 250 miles.

Besides these rivers there are numerous small creeks entering from both sides, which carry very little water in the dry season.

These four rivers just described are all clear-water streams, with the exception of the Boggy, which has a muddy color given it by a tributary called the Muddy Boggy entering it 35 miles from the mouth.

FLOODS.

As from Kimishi River to the Little River, which is 3 miles above Fulton, a distance of 152 miles, there are no feeders to the Red River, the great amount of water which

falls in the country near the headwaters of the Red River and its tributaries finds a very open outlet into this long reach of river, which, on account of the level country surrounding it, is not swelled by the amount of local rainfall. The floods, therefore, in this upper part of the river, where all its main tributaries empty within 110 miles of river, are naturally very quick and of very short duration.

The floods occur in February and June, the latter being the greatest. They rise in ten hours to their greatest height, and remain at that stage from one to two weeks, when the water falls to very little, if any, above low water, and with slight oscillations of from 6 inches to 1 foot remain at this stage throughout the year.

The greatest oscillation noticed by river men at Denison was 28 feet and the duration of the flood at this stage, which was the longest noticed, was two weeks, while the shortest duration of the floods was five days.

The current is very rapid, increasing from a velocity of 2 miles at low water to 7 miles at high water. Large quantities of drift are carried by the high water, which either float down into the lower river or sink into the sand.

In 1877 the Missouri, Kansas and Texas Railway Bridge, a wooden structure, built upon piers which were not sunk to a rock foundation, but built upon a crib of sheet piling, was washed away by the high water lodging against a wagon bridge, half a mile below, of a similar build. The river being thus obstructed the drift accumulated to such an extent that the wagon bridge was not able to sustain the great strain thus brought upon it. Two of these piers remain standing, in good condition.

The high water overflows the surrounding country only in a few low places, and is backed up for a very short distance before it reaches the second or reinforce banks, which extend along the river gradually decreasing in height, and diverging from the main banks.

The rise of 1877 was the largest oscillation by 10 or 12 feet ever noticed upon the river.

The Red River, forming the boundary between the Indian Territory and Texas, has on its south bank a very extensively cultivated country, while on its north bank a very small portion of the available land is used for any enterprise. The few farms noticed were worked by white men, who intermarry with the Indians for the purpose of obtaining the same rights which they enjoy.

Very fine, large quantities of timber are found on the north side, a very short distance from the river, the most valuable and important of which is walnut, hickory, ash, yellow pine, and the different colored oaks. On the south side the timber is chiefly oak and pine, with small quantities of hickory and ash and gum.

Large quantities of stone are found on both sides, it being principally sand and lime stone, with small quantities of granite of such a nature as to unfit it for building purposes. The sand and lime stone does not occur in regular stratas, as would be expected, but is thrown up in every conceivable shape, bearing testimony of past eruptions.

On the Texas side a great many towns have been built within a few miles of the river. They are connected by numerous railways, owned by different companies, thus affording almost all the competition necessary for the welfare of the towns, which are all in a very flourishing condition.

The chief exports are cotton and wheat; an estimate of the amount of these exports and the merchandise imported to the towns could only be obtained by consulting the forwarding and receiving books of the many railway stations. A rough estimate, given by a gentleman in Denison, was 150,000 bales of cotton, raised upon a stretch of country extending from the mouth of the Little Wichita River to Texarkana, a distance of 250 miles, and 20 miles wide.

Four miles north of Denison the Missouri, Kansas and Texas Railway Company have built a bridge across the river, of the Howe truss patent. It is built upon very high banks and is 636 feet long, containing four piers of stone, three of which have been sunk to stone, while the one nearest the north bank is built upon a foundation of *pierre perdue*. The superstructure consists of four spans, built of wood and iron, viz, wooden upper chord and posts and iron lower chord and braces and ties. It is rumored that the railway company are contemplating the building of a new bridge, which is to be of iron, with rock foundations.

IMPROVEMENT.

In order to improve the Red River so as to make navigation possible for six months in the year, it would be necessary to confine the water to a channel of not more than 200 feet in width. This would require the building of dams, dikes, and bank protections upon a material which cannot be controlled except by the expenditure of a large amount of money for very elaborate work, the execution of which is not warranted by the amount of commerce which the country has.

The problem of transportation has been clearly demonstrated by the railways, without taking the river as a factor. In order to make the river navigable from the

mouth of the Washita to the mouth of the Kimishi River, a distance of 110 miles, it would require not less than $10,000 per mile, making a total amount of $1,100,000, and it is questionable if this large amount would make the improvement permanent.

It is not advisable to make any estimate of the cost of improvement above the Washita, as in some years the river carries no water for a month, and during the remainder of the year the volume of water is so small that it could not be put to any practicable use.

As a drain to carry off the surplus water of the country the river answers every purpose, but to improve it permanently for safe navigation for six months in the year would be an undertaking which would not be accomplished without the expenditure of a large amount of money, which is not warranted by the amount of commerce of the country, and if accomplished, would not prove beneficial to the people.

Very respectfully, your obedient servant,

MAX A. ORLOPP, JR.,
Assistant Engineer.

Capt. H. S. TABER,
United States Engineers.

V 17.

EXAMINATION OF PETIT JEAN RIVER, ARKANSAS.

UNITED STATES ENGINEER OFFICE,
Little Rock, Ark., November 3, 1884.

GENERAL: In pursuance with the requirements of your letter of July 31, 1884, I have the honor to furnish the following information relative to the question whether or not the Petit Jean River is "worthy of improvement."

* * * * * * *

From assistant's report it appears—

1st. Stream is never navigable above Danville.

2d. It can only be made navigable at low water from Danville to mouth by lock and dam system, a system used only where navigation is of vital importance, warranting large outlay.

3d. The commerce warrants an expenditure upon this stream.

4th. High-water navigation is all that it is worth while to attempt to secure, with No. 3 kept in view.

5th. His report gives all the data necessary to make an enlightened estimate of the amount required without further survey.

PRESENT COMMERCE.

From assistant's report:

15,000 to 20,000 bales of cotton.
400,000 to 600,000 bushels of corn.
Merchandise imported equals 1,000 tons.

From Mr. Harkey:

24,000 to 30,000 bales of cotton by himself and others, and 400,000 pounds way freight.

Future commerce is hard to estimate, but judging from personal observation and views of intelligent, unprejudiced men, it is likely to be trebled and even quadrupled inside of ten years.

The assistant's report will be found appended and marked A.

Information in regard to commerce not found in No. 2 will be found appended and marked B.

RECOMMENDATIONS AND REMARKS.

From conversations had with the assistant who made examination, taken together with his report, I am satisfied that his recommendations

in regard to the stream are practically the best that can be made. An appropriation of $7,000 could be well expended upon this stream, and in such a manner as to develop the prosperity of this particular section. This stream should be classed with the Fourche la Féve and the Saline rivers, and has more merits than either of them in some respects. The method of improvement as set forth in Mr. Orlopp's report is fully approved.

I am, general, very respectfully, your obedient servant,

H. S. TABER,
Captain of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers.

A.—REPORT OF MR. MAX A. ORLOPP, JR., ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Little Rock, Ark., October 20, 1884.

CAPTAIN: I have the honor to make the following report of an examination of the Petit Jean River:

According to your letter of instructions of the 14th of October, I proceeded by rail and stage to Danville. At this place I procured a skiff and proceeded down the river for a distance of 27 miles, where I was forced to abandon the skiff on account of the great quantity of drift in the river.

The distances given in this report are calculated from the speed of the boat.

As my efforts to obtain a barometer in Little Rock were not successful no observations for elevations were taken.

The stage of water at the time of the examination was very low, thus enabling me to see the river in its worst phase and to judge of its condition at high water.

Soundings were taken in the channel and on sections very frequently; attention was also, paid to the character of the bottom and the depth of same.

The Petit Jean River rises in the Indian Territory, near the western boundary of Arkansas, on the thirty-fifth parallel of latitude.

In its course through Arkansas it resembles a small mountain stream until it reaches Danville, which is situated on its right bank about 45 miles from its mouth.

Where the river flows under the bridge at Danville it has a width of 25 feet and a depth of water which is barely sufficient to moisten the small stones which compose the bottom. The width and depth do not vary for a distance of 400 feet from the bridge, where it attains a width of 100 feet, which is retained throughout its course to where it empties into the Arkansas River.

From Danville it flows through an alluvial bottom, winding in and out and folding back upon itself in a series of short and sharp bends. The longest reach noticed was not over one-fourth of a mile in length, while the bends were very abrupt, the angle formed by the line of bank produced being never greater than a right angle and very frequently less.

The river from Danville to its mouth consists of five long lakes, which are separated from each other by rock shoals.

These rock shoals are the continuation of the strata of rock from the spurs of the Petit Jean Mountain, the water having, by its erosive force, cut through the stone, which is shown by the ridges on both sides of the river.

The first lake has its beginning about 400 feet below the bridge at Danville, and continues for a distance of 3 miles, where it is separated from the second lake by a shoal of small sandstone 300 feet long, and which is known to the people in the surrounding country as the Fish-Trap Shoal.

This lake has a depth of from 4 to 8 feet, with no perceptible current.

The second lake, beginning at the foot of Fish-Trap Shoal, is divided from the third lake by Jones's Shoal. The depth varies from 2 to 6 feet.

The third and fourth lakes are formed by Rocky Crossing, which is 25 miles from Danville, thus making the third lake, 12 miles long, and it has a depth from 1½ to 7 feet.

Eight miles below Rocky Crossing the last rock shoal extends across the river and divides the fourth lake from the last one. In these two lakes the water has a depth from 2 to 8 feet.

The fifth lake or the part of the river between the last rock shoal and the mouth is the only lake which has any perceptible current, which is a very sluggish one, averaging one-half mile an hour.

The Petit Jean Mountain continues down the Arkansas for a distance of 1 mile. Against this mountain the Arkansas River strikes at a right angle; being deflected to the left, forming a very sharp bend.

SHOALS.

The only shoals of any consequence, and which are the means of making navigation impossible, are the four rock shoals, previously mentioned, which divide the river into five lakes. The Fish-Trap Shoal, 3 miles from Danville, is 300 feet long, having a width of 25 feet, and the water barely covering, but running very rapidly over the rocks. As near as could be ascertained, this shoal has afall of 3½ feet.

In the second lake two clay shoals were observed, both having a length of 100 feet and an average depth of 1 foot. These shoals are formed by the drift which has accumulated at these points, and causing deposition of the sediment suspended in the water. As the bottom is formed of a very soft clay they would be washed out by the high water should the drift be removed.

Jones's Shoal is situated about 13 miles from Danville. It is a rock shoal 400 feet long, with a width of 75 feet, and an average depth of 3 inches. The fall of the water over this shoal is about 4 feet. At the head of this shoal a small island has been formed, 75 feet long by 20 feet wide, and is the only island in the river.

The right chute is 100 feet wide, through which no water flows at low water, the channel deflecting very sharply to the left. The left chute is 25 feet wide and very shallow.

Between Jones's Shoal and Rocky Crossing two clay shoals were observed. The first, about 5 miles from Jones's Shoal, is 100 feet long, with an average depth of 8 inches. This shoal being similar to the other clay shoals described above, offers no obstruction to navigation.

The second shoal, known as McCullough's Ford, is 3 miles above Rocky Crossing.

It is 250 feet in length, 100 feet wide, with an average depth of 1½ feet. The bottom is formed of red clay.

Rocky Crossing Shoal is situated about 17 miles from the mouth of the river. This shoal has its beginning at the point where the river cuts through Surrounded Ridge.

The ridge bluffs sharp up to the river; it is formed of slate and sandstone, and has a height of 25 feet above low water. The shoal is about 1¼ miles in length, 75 feet wide; the water, with the exception of 400 feet, being forced over the rocks. At the head of this shoal the river is spanned by a bridge of three spans and two approaches. The channel span is 100 feet long; the other two spans 60 feet, and the approaches 100 feet inclined at an angle of 15 degrees from the horizontal.

This bridge is an obstruction to navigation in time of high water.

At this point the river is also obstructed by a dam of rock 2½ feet in height. This dam has been built for the purpose of making a fish trap, and can be easily removed.

Eight miles below Rocky Crossing the last shoal was observed.

The river approaching within a quarter of a mile of the mountain, the shoal is formed by a spur of rock projecting almost due north from the mountain.

It is 300 feet in length, 75 feet wide, with an average depth of 6 inches.

With the exception of these shoals the water in the river has a depth of from 4 to 6 feet, but as almost all the fall which the river has is given by these shoals, should these shoals be cut out it would be the means of draining the river, the shoals acting as large dams to keep the water back.

The bed of the river is a very soft gray clay, in which is deposited the drift of ages. A pole was pushed into this clay for a distance of 4 feet without any exertion before a firmer substance was encountered. This subsoil is generally slate and sandstone. The sounding was repeated at several places and the only difference observed was that the clay differs in color and attains a greater depth near the mouth.

From Danville to the mouth of the river the banks, with the exception of three small slate points, are of red and gray clay; having a height of 15 feet at Danville, they gradually decrease to a height of 12 feet at the mouth.

The overhanging timber from each bank meets overhead, thus forming an arbor nearly the whole length of the stream.

Generally the banks are caving at the top, thus precipitating the trees into the river, which catch and back up the drift for a distance of two and three hundred feet.

The Petit Jean has an oscillation at Danville of 15 feet and at Rocky Crossing of 16 feet.

The high water overflows its banks and inundates the country at Danville a quarter of a mile on each side of the river, and as the country becomes more flat as the river nears the Arkansas River the overflow reaches for nearly a mile on the left bank, but the nature of the country on the right bank does not allow it to back up more than a quarter of a mile. The high water is a great detriment, not only to the country which it prevents being worked, but also to the river, as it is the means of conveying all of the fallen timber on the overflowed land into the bed of the river, where it very

readily lodges in the clay, forming snags and drifts, which were so numerous that it was impossible to keep any record of their number.

Rock heaps and drifts were encountered every 500 or 600 feet, and in many places it became necessary to drag the boat around or over them.

From Rocky Crossing to the mouth the drift has been cut up and the overhanging timber felled into the river, under the supervision of Mr. John Harkey, who is building a small boat to run as far as Rocky Crossing in time of high water.

Soon after this drift had been cut there was a small rise in the river, which was only sufficient to gather this timber in very large drifts, where it now remains for a greater rise to carry it out.

The first high water will clear the river to Rocky Crossing, making navigation comparatively safe.

The water attains its greatest depth about the middle of January, and remains at this height for a week, during which time travel is greatly retarded. It then falls 8 or 9 feet, and, with small oscillations, retains this height until the first part of June, thus allowing navigation to be safe and sure for five months.

ESTIMATED COST OF IMPROVEMENT.

As it would be impossible to improve the navigation of the Petit Jean River at low water without the building of four locks to cross the boats over the shoals, this estimate is made for making navigation less precarious at high water.

It would only be necessary to clear the banks of overhanging timber and remove the snags and drift from the river. The following is the estimate:

One foreman in charge, per month	$100
Twenty axmen, at $30 per month	600
Subsistence, at 50 cents per day	495
Total for one month	1,195
Four months, at $1,195 per month	4,780
Outfit	1,200
Contingencies	500
	6,480

The land in the valley of the Petit Jean is a very rich, loamy clay, varying in depth from 4 to 12 feet.

The subsoil being of slate and sandstone, and so near the surface, is the cause of the soil being of such a thirsty nature, and hence a drought of any duration is very severely felt.

From the merchants at Danville and Dardanelle I learned that the valleys of Petit Jean, Fourche la Fève, and Duchesse Creek shipped yearly from 15,000 to 20,000 bales of cotton, from 450,000 to 600,000 bushels of corn, and raised for their own use from 15,000 to 20,000 bushels of wheat.

The amount of merchandise imported to Danville will amount to 1,000 tons. This is all hauled by wagons from the railroad depot at Morristown, a very small place on the Arkansas River, opposite Dardanelle.

Coal of a very chaffy nature without any capping abounds in great quantities, especially on the Reveille Creek, which empties into the Petit Jean about 6 miles above Danville. Coal is also found on Hightown Prairie, which is situated 4 miles to the north of Rocky Crossing. The better coal is not of a very fine quality.

Some indications of iron were seen, but no attempt has ever been made to develop the mineral wealth in this country.

On Magazine Mountain, which is situated 6 miles north of Danville, fine quarries of a very superior white sandstone exist.

The timber is very plentiful, and of a very heavy and fine quality. The most numerous and valuable are yellow pine, black and scaly-bark hickory, white and black ash, sweet and black gum, red, white, black post pine, water and willow oaks, sycamore, and elm; also mulberry, Spanish mulberry, dogwood, hornbean, box-elder, willow, and persimmon.

The country in the valley of the Petit Jean is not very thickly settled, but each year shows an increase in the population.

The want of transportation of their produce to markets is the only drawback which the country has, and I think that navigation of the Petit Jean, if open only for five months in the year, would cause a great change for the best.

The only towns in the valley of the Petit Jean are Danville, situated 45 miles from

the mouth, on a slate bluff, and Ola, about 17 miles from the mouth and 4 miles south of the river.

Danville, the county seat of Yell County, has a population of 400, and is the main trading point in the valley for a distance of 60 miles.

Ola has a population of 100, and supplies only the eastern end of the valley.

Very respectfully, your obedient servant,

MAX A. ORLOPP, JR.

Capt. H. S. TABER,
Corps of Engineers, U. S. A.

B.—LETTER OF MR. I. M. HARKEY.

OLA, ARK., *October* 27, 1884.

In answer to your within, for the last four years I have hired a boat to make from two to three trips each year, and sent out from 200 to 300 bales cotton annually; and if a boat was running regularly I would be able to ship from 1,200 to 1,500 bales, and would receive anyhow as much as 200,000 pounds way freight, and am satisfied that there would be double the amount done by others.

Very respectfully,

J. M. HARKEY.

Capt. H. S. TABER.

APPENDIX W.

REMOVING SNAGS AND WRECKS FROM THE MISSISSIPPI AND MISSOURI RIVERS—IMPROVEMENT OF OSAGE RIVER, MISSOURI AND KANSAS; GASCONADE RIVER, MISSOURI; WABASH RIVER, INDIANA AND ILLINOIS, AND WHITE RIVER, INDIANA.

REPORT OF MAJOR A. M. MILLER, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1885, *WITH OTHER DOCUMENTS RELATING TO THE WORKS.*

IMPROVEMENTS.

1. Removing snags and wrecks from the Mississippi and Missouri rivers.
2. Osage River, Kansas and Missouri.
3. Gasconade River, Missouri.
4. Wabash River, Indiana and Illinois.
5. White River, Indiana.

EXAMINATIONS.

6. Nish-na-botna [Nishnabotana] River, with a view to increasing the depth of channel in the Missouri River.
7. Kankakee River, Indiana.
8. Wabash River, Indiana, from Logansport to Delphi.

UNITED STATES ENGINEER OFFICE,
Saint Louis, Mo., July 23, 1885.

GENERAL: I have the honor to forward herewith my annual reports upon the river and harbor improvements in my charge for the year ending June 30, 1885.

Very respectfully, your obedient servant,

A. M. MILLER,
Major, Corps of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

W 1.

REMOVING SNAGS AND WRECKS FROM MISSISSIPPI AND MISSOURI RIVERS.

I assumed charge of these works on December 1, 1884, relieving Maj. C. R. Suter, Corps of Engineers, U. S. Army, by virtue of the Special Orders, No. 118, paragraph 6, headquarters Corps of Engineers, U. S. Army, Washington, D. C., September 10, 1884.

Two boats were employed during the working season, the H. G. Wright working in the Missouri and Mississippi rivers, and the J. N.

Macomb in the Mississippi River. To facilitate work the Mississippi River was divided in two beats, one extending from the mouth of the Missouri River to Helena, Ark., and the other from Helena, Ark., to Vicksburg, Miss. The H. G. Wright was assigned to the upper reach, and, in addition, did what work was required on the Missouri River.

MISSISSIPPI RIVER.

On this stream the J. N. Macomb was at work seven months and the H. G. Wright four and a half months. Operations extended from the mouth of the Missouri River to Vicksburg, Miss.

The boats were kept at work as long as the state of the river and ice permitted.

Table of work done in Mississippi River.

Names of boats.	Number of snags pulled.	Weight, in tons of 2,000 pounds.	Number of trees cut.	Number of miles run.
H. G. Wright	482	10,543	14,331	1,624
J. N. Macomb	1,210	19,676	2,569	3,718
Total	1,692	30,219	16,900	5,342

The snag-boat De Russey should be rebuilt; her machinery can be utilized. She should be arranged for removing wrecks as well as snagging; it is estimated that this can be done at a cost of $50,000.

ESTIMATES.

For rebuilding one wooden snag-boat and fitting it up for wrecking purposes	$50,000 00
For working expenses of three boats, eight months each, at $4,000 per month	96,000 00
For repairs, incidental work, and contingencies	15,000 00
Total	161,000 00

Money statement.

July 1, 1884, amount available	$900 23
Amount allotted by act approved July 5, 1884	72,950 63
	73,850 86
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	45,395 27
July 1, 1885, amount available	28,455 59
Amount that can be profitably expended in fiscal year ending June 30, 1887	161,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

MISSOURI RIVER.

Work on this river was begun August 11, 1884, and the H. G. Wright worked on the river until October 29, 1884.

Table of work done in Missouri River.

Name of boat.	Number of snags pulled.	Weight, in tons of 2,000 pounds.	Number drift piles removed.	Number of trees cut.	Number of miles run.
H. G. Wright	1,041	14,610	11	1,353	813

Bids were advertised for for the construction of the hull of a steel and iron snag-boat for the Missouri River, and the following bids were received:

Abstract of bids received for building the hull of a steel and iron snag-boat, opened March 28, 1885, by Maj. A. M. Miller, Corps of Engineers, at Saint Louis, Mo.

No.	Names of bidders.	Residence.	Price.
1	Iowa Iron Works Company, William Hopkins, superintendent	Dubuque, Iowa	$57,900
2	James Rees	Pittsburgh, Pa	51,500
3	Allen & Blaisdell	Saint Louis, Mo	58,740

The contract was awarded to James Rees, of Pittsburgh, Pa., he being the lowest responsible bidder. The hull is now under process of construction.

Proposals for the construction of the engines and machinery have been invited, and will be opened July 14, 1885.

It is expected that the cost of the boat will be within the amount set aside, $105,000, for its completion. It certainly will come within the amount if the bids for engines and machinery are as favorable as those for the hull.

ESTIMATES.

For outfitting and completing snag-boat	$10,000 00
For operating boat nine months, at $4,000 per month	36,000 00
For repairs, incidental expenses, &c	10,000 00
Total	56,000 00

Money statement.

July 1, 1884, amount available	$81,644 75
Amount appropriated by act approved July 5, 1884	50,000 00
	131,644 75
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	18,296 04
July 1, 1885, amount available	113,348 71
Amount that can be profitably expended in fiscal year ending June 30, 1887	56,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

OPERATIONS FOR COMING SEASON.

Owing to the failure of the river and harbor bill for the year ending June 30, 1886, there can be but little work done. It is proposed with

the funds available to do about six weeks' work on the Missouri River and six months' work on the Mississippi, the work to be done by the H. G. Wright.

W 2.

IMPROVEMENT OF OSAGE RIVER, KANSAS AND MISSOURI.

I assumed charge of this work on September 30, 1884, relieving Maj. O. H. Ernst, Corps of Engineers, U. S. Army, by virtue of Special Orders No. 118, paragraph 7, headquarters Corps of Engineers, U. S. Army, Washington, D. C., September 10, 1884.

The project for the improvement of this stream consisted in the removal of obstructions to navigation, cutting of leaning timber, construction of cross-dams and wing-dams, and in dredging channels through shoal places.

No work has been done upon this improvement for the last two seasons, no money having been appropriated for that purpose. With the small balance remaining on hand at the beginning of the present fiscal year, the gauge readings at Tuscumbia, Mo., have been kept up.

No appropriation having been made for the coming fiscal year, no work will be done. With the appropriation asked for fiscal year ending June 30, 1887, it is proposed to remove snags and other obstructions, and cut the leaning trees, and make some necessary repairs to dams, this being the only work that can be done to advantage upon this stream.

The estimated cost of this improvement was $230,000.

The former appropriations are:

By act of March 3, 1871	$25,000
By act of June 10, 1872	25,000
By act of March 3, 1873	25,000
By act of June 23, 1874	25,000
By act of June 18, 1878	20,000
By act of March 3, 1879	20,000
By act of June 14, 1880	30,000
By act of March 3, 1881	20,000

Money statement.

July 1, 1884, amount available	$143 74
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	143 74
Amount that can be profitably expended in fiscal year ending June 30, 1887 Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	5,000 00

COMMERCIAL STATISTICS.

No reliable data could be obtained upon which to base an itemized statement of the commerce of this stream. The down freights consist of country produce, live stock, lumber, and railroad ties, and the up freights of a corresponding amount of farm supplies.

The following steamboats navigate the stream:

Steamer Frederick, 100 tons, from mouth up.
Steamer Emma, 100 tons, from mouth up.
Steamer Hurlburt, 75 tons, from mouth up.
Steamer Anna, 50 tons, from mouth up.
Steamer Aggie, 400 tons, Missouri River and Osage River.
Steamer General Meade, 500 tons, makes weekly trips from Saint Louis to Saint Elizabeth.

W 3.

IMPROVEMENT OF GASCONADE RIVER, MISSOURI.

I assumed charge of this work on October 15, 1884, relieving Maj. C. R. Suter, Corps of Engineers, U. S. Army, by virtue of Special Orders No. 118, paragraph 6, headquarters Corps of Engineers, U. S. Army, Washington, D. C., September 10, 1884.

The improvement of this stream has consisted in the removal of obstructions to navigation in the shape of leaning timber and snags and the construction of low wing-dams to facilitate the passage of boats over the shoals during low water.

The work was commenced in 1880 and has been continued up to the present time.

During the past season a party was organized and commenced field operations on September 28, 1884, and continued until November 15, 1884. The work done consisted in clearing the river from Indian Ford to the mouth, a distance of 78¼ miles, of obstructions. One hundred and ninety-four snags were pulled and properly disposed of and the banks were cleared of all timber which might obstruct navigation or be washed into the river. Repairs were also made to wing-dam at Round Island.

No appropriation having been made for the coming fiscal year no work will be done. With the appropriation asked for fiscal year ending June 30, 1887, it is proposed to continue the work as heretofore, that being all that can be advantageously done.

The estimated cost of this improvement was $50,000. The former appropriations are:

By act of June 14, 1880	$5,000
By act of March 3, 1881	10,000
By act of August 2, 1882	10,000
By act of July 5, 1884	5,000

Money statement.

Amount appropriated by act approved July 5, 1884	$5,000	00
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	3,875	28
July 1, 1885, amount available	1,124	72
Amount (estimated) required for completion of existing project	20,000	00
Amount that can be profitably expended in fiscal year ending June 30, 1887	10,000	00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

There are four steamboats engaged in navigating this stream, having a tonnage of from 65 to 100 tons and drawing from 12 to 16 inches of water.

The following is a statement of the traffic done on the river during the last fiscal year:

Articles.	Quantity.	Value.
Wheat ..... bushels	226,750	$181,400
Live stock ..... head	1,150	12,500
Lumber ..... feet	400,000	7,600
Railroad ties	175,000	56,000
Miscellaneous produce	.....	3,000
Up freights	.....	26,000
Total	.....	286,500

W 4.

IMPROVEMENT OF WABASH RIVER, INDIANA AND ILLINOIS.

This work was turned over to my charge by Capt. J. C. Post, Corps of Engineers, U. S. Army, on October 4, 1884, by virtue of Special Orders No. 118, paragraph 8, headquarters Corps of Engineers, U. S. Army, Washington, D. C., September 10, 1884.

IMPROVEMENTS BELOW VINCENNES.

An examination of the Wabash River, Indiana and Illinois, with a view to its improvement, was made by the late Lieut. Col. (then Major) G. Weitzel in 1870. In his project for the improvement of the river, submitted on January 4, 1872, he recommends the removal of certain obstructions and the building of a lock and dam at Grand Rapids. In the subsequent reports of operations by all the officers in charge of this work an appropriation has been urged for this lock and dam.

Lieut. Col. William E. Merrill, in his report for the fiscal year ending June 30, 1873 (Report of Chief of Engineers, 1873, pages 511, 512 and 516, 517), reports as follows:

> The most serious obstruction on the Wabash River is the Grand Rapids, 2 miles above the mouth of the White River and 110 miles above the mouth of the Wabash. This place was once improved by the Wabash Navigation Company, incorporated by the States of Indiana and Illinois, but the lock and dam built by them has gone to ruin and is now a worse obstruction than the original rapids. I reported fully on this work in my letter of May 3, 1873, and the following is quoted therefrom: "The Grand Rapids of the Wabash River are naturally the most serious obstructions in the navigable portion of the river. This obstruction was once done away with by the construction of a lock and dam, but the work being now entirely unserviceable, the river is in a worse condition than ever before. No radical improvement and no useful partial improvement can be made while the present condition of affairs is maintained."
>
> * * * * * * *
>
> Pages 516, 517.—In the second place, I wish to record my decided opinion that until a serviceable lock and dam is built at Grand Rapids it is a complete waste of money to improve any other part of the Wabash River. The first work to be done is to rebuild the lock. Until this is accomplished it is not safe to touch the dam, as in all probability the lock only remains in place because the break in the dam reduces the pressure of the water. * * * I would therefore recommend that the next annual appropriation for the improvement of the Wabash be put at $150,000.
>
> If less than this sum is appropriated I trust that I will be permitted to retain it on hand until the succeeding appropriation becomes available. The condition of affairs at Grand Rapids is such that it would be folly to attempt any work on the lock unless we have money enough to complete it, and it is almost equally foolish to spend money improving parts of the river while leaving untouched an insuperable obstruction that cuts the river in two.

For the fiscal year ending June 30, 1875, an appropriation of $9,000, or so much thereof as was necessary, was made to purchase from the Wabash Navigation Company any rights, title, or claim in the lock and dam at Grand Rapids, and for the extinguishment of any right said company may have to affect or interfere in any way with the navigation of the river, and this was done at a cost of $7,000. For the year ending June 30, 1885, an appropriation for the lock and dam of $30,000 was made. Under this appropriation a contract was entered into for the purchase and delivery of a small portion of the stone for the lock. The following is an abstract of the bids received:

Abstract of proposals for stone for lock at Grand Rapids, opened at Cincinnati, Ohio, September 30, 1884, *by Capt. James C. Post, Corps of Engineers.*

Names of bidders.	Prices per cubic yard.						Total.
	Cut stone.		Squared stone.	Backing stone.	Special stones.	Coping stone.	
	Dressed face.	Quarry face.					
Carmody & Maple.....	$11 00	$10 00	$8 00	$7 00	$15 75	$14 50	$65,947 00
M. J. O'Connor	12 50	10 50	9 00	7 00	16 00	16 00	70,297 50
Henry Helm	12 30	10 80	10 15	10 00	15 60	14 25	80,113 60
Stanislaus & Bernhart	13 50	12 00	10 50	9 50	20 00	23 00	87,363 50
J. V. Hoag, jr.....	18 00	16 50	15 50	15 00	22 50	1 00	109,850 00
Hoosier Stone Company....	21 90	20 10	15 50	13 50	23 10	23 10	123,358 10

The contract was awarded to Carmody & Maple, they being the lowest responsible bidders, and as much of the stone as the funds available would permit was to be delivered by July 1, 1885. This date was subsequently extended to November 1, 1885, by letter from Chief of Engineers, U. S. Army, dated May 28, 1885. No stone has as yet been yet been delivered under this contract.

I do not consider it good policy, in the interest of economy, to expend any money in the improvement of the river above Grand Rapids until the lock and dam shall have been completed. The river below has been improved in previous years and is now in a tolerably fair condition, requiring very little new work and repairs to the works already constructed. In view of the above facts I would recommend that until the completion of the lock and dam work on the river be confined to the portion between the mouth and Grand Rapids. This part of the river is the connecting link between the White River, Indiana, and the Ohio River, and is important in connection with the navigation of the White River, as without its improvement navigation of the White River would be comparatively valueless.

There has been very little navigation or commerce above Grand Rapids during the last year, two boats only making occasional trips from Vincennes to Terre Haute, and these boats have been sold and taken out of the river. I have been informed that a boat is to be built for this trade, but as there are railroads running parallel to the river which do nearly all the carrying trade I do not think the boat will be built until the river has been made navigable from Terre Haute to its mouth, when a paying trade could be carried on the river by moving the crops to the Ohio.

No work has been carried on below Grand Rapids, on account of lack of funds, except some repairs to the plank revetment to the New Harmony Dam. No work will be done during the ensuing season, as no appropriation was made for the improvement of the river.

CONDITION OF THE RIVER.

At low water the worst obstructions below Mount Carmel are two extensive sand-bars, known as Widow Goss and Skidmore bars. At extreme low water they are impassable for any class of steamers plying on the river. The channel here can be improved by means of contraction works or wing-dams. The estimated expense at both places is $20,000.

At Little Chain a channel has been cut through with a width of 35 feet. This should be increased in width to 100 feet, at an estimated cost of $20,000.

Grand Chain.—The work at this point has consisted in the cutting a channel through the rocky reef and the building of a guide dike at head of cut. This work is incomplete, and according to previous estimates requires the expenditure of $25,000 to complete it.

The river near Grayville is in a condition which requires immediate attention. Here a serious "cut-off" is threatened, which will shorten the river about 3 miles, and by this sudden change of slope cause serious injury to navigation. The cut-off would also cause Grayville a great loss, as its principal business is sawing lumber, which would be entirely destroyed, as the cut-off would leave the town about 1½ miles from the channel of the new river. Steps should be taken to prevent this cut-off, and it is estimated that a sum of $20,000 could be judiciously expended for this purpose.

Dam at New Harmony.—This work was intended to close the chute at New Harmony, prevent the river from making this a cut-off, and confine the low water to the channel proper. The dam has required constant repairs since its construction, the tendency of the river being to cut around its root by constantly washing away the bank of the island on which it rests. It will require repairs each season until the chute becomes filled up. It will probably require the expenditure of $5,000 for the fiscal year ending June 30, 1887.

The effect of the improvements hitherto carried on has been to greatly facilitate the navigation of the river.

No work will be done during the coming fiscal year, no funds having been appropriated for that purpose.

ESTIMATES.

For lock and dam at Grand Rapids	$150,000
(Of this amount $80,000 should be appropriated for fiscal year ending June 30, 1887.)	
For work at Widow Goss and Skidmore bars	20,000
For work at Little Chain	20,000
For work at Grand Chain	25,000
To protect bank at Grayville	20,000
For repairs of snag-boat and one year's snagging	10,000
For repairs of completed works, maintenance of plant, and contingent expenses	15,000
Total	260,000

Money statement.

July 1, 1884, amount available	$1,756 07
Amount appropriated by act approved July 5, 1884	30,000 00
	31,756 07
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	4,580 61
July 1, 1885, amount available	27,175 46
Amount (estimated) required for completion of works indicated	260,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	190,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

With this amount asked for fiscal year ending June 30, 1887, it is proposed to continue the works as indicated above.

IMPROVEMENT FROM VINCENNES TO TERRE HAUTE.

By the river and harbor act passed July 5, 1884, making appropriations for fiscal year ending 30, 1885, $10,000 of the $40,000 appropriated

was for the improvement of the river between Vincennes and Terre Haute.

The work on this portion of the river consisted of the completion of the dam at Horseshoe Island and the removal of snags from the channel.

REMOVAL OF SNAGS.

The work of removal of snags was begun on August 25 and continued until December 15, when further operations were prevented by running ice. The fleet was then taken to Vincennes, laid up, and the crew discharged. The fleet was subsequently moved to Mount Carmel and cared for with the other floating plant pertaining to the river. The work since has consisted in the care of plant.

There were removed from the river 377 snags, weighing 1,483 tons; overhanging trees removed, 117, and 1 wreck of flat-boat. In addition 30 piles were removed from the draw in the Ohio and Mississippi Railway Bridge at Vincennes, the expense therefor being borne by the railway company. To accomplish this work the steamer Osseo ran 489 miles.

DAM AT HORSESHOE ISLANDS.

This work began May 15, 1884, and was completed August 16, 1884. Its dimensions are as follows:

	Feet.
Length of dam	220
Width	60
Greatest height	18
Least height	6
Height above low water	2

In addition 465 linear feet of shore protection for the roots of the dam was constructed.

The estimate for snagging submitted for the river covers any possible work that may be required in the upper river.

Money statement.

July 1, 1884, amount available		$1,978 86
Amount appropriated by act approved July 5, 1884		10,000 00
		11,978 86
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$8,701 77	
July 1, 1885, outstanding liabilities	267 50	
		8,969 27
July 1, 1885, amount available		3,009 59

COMMERCIAL STATISTICS.

Repeated efforts were made to obtain an itemized statement of the commerce of this stream, but without success.

An increased demand for, and value of, certain kinds of timber heretofore considered as useless for manufacturing purposes, has given a decided impetus to the navigation of this stream as well as White River. Four good-sized steamboats have been exclusively employed in towing rafts.

The following is a list of the boats navigating Wabash and White rivers:

Names.	Where plying.
Belgrade	Vincennes to Terre Haute.
Belle of Fountain	Do.
Cornelia	Terre Haute and above.
J. H. Russell	Do.
Ida Lee	Do.
Experiment	Vincennes and other ports.
D. L. Goodwin	Mount Carmel and other ports.
Montezuma	Do.
Alice Cary	Grayville and other ports.
John R. Hugo	New Harmony and other ports.
Rosa Belle	Hazelton and above on White River.
Helen Pratt	Do.
New boat (building)	Do.

W 5.

IMPROVEMENT OF WHITE RIVER, INDIANA.

This work was turned over to my charge by Capt. J. C. Post, Corps of Engineers, U. S. Army, on October 4, 1884, by virtue of Special Orders No. 118, paragraph 8, headquarters Corps of Engineers, U. S. Army, Washington, D. C., September 10, 1884.

The first appropriation for improvement of White River, Indiana was made by act of March 3, 1879, since which date work has been carried on for the improvement of the river. The work has consisted in the removal of snags and a reef of rock known as Kelly's Ripples, about 6 miles above the mouth of the river.

During the fiscal year ending June 30, 1885, the work was confined to the removal of the rock at Kelly's Ripples, the improvement here contemplating a channel 100 feet wide and 3½ feet deep at low water.

During the working season the work of removing rock was continued, and at present there is a low-water channel throughout the whole length of the ripple of 50 feet wide and of the required depth. The rock was removed by blasting and loosening with dynamite, and then excavating with dredge. The amount of material moved was 17,701 cubic yards.

Operations for the year ending June 30, 1886, will consist in the care of plant. No appropriation having been made, no other work can be done.

Proposed operations for fiscal year ending June 30, 1887, will consist in the completion of the cut through Kelly's Ripples. It is estimated that an appropriation of $15,000 will complete this work. It is not considered advisable to attempt any other work on White River until the removal of the obstruction at Kelly's Ripples is completed, as the river is not navigable at low water while this obstacle exists. It is very desirable that the whole amount be appropriated, as the work can be finished in one favorable season.

CONDITION OF THE RIVER.

The cut at Kelly's Ripples has opened the river to low-water navigation as far as Hazelton. Above Hazelton, it is not at present an economical expenditure of funds to attempt any improvement of the river, as long as the railroad bridge at this point remains as at present, an obstruction to navigation, as described in previous reports.

Money statement.

July 1, 1884, amount available	$3,889 99
Amount appropriated by act approved July 5, 1884	10,000 00
	13,889 99
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	12,838 57
July 1, 1885, amount available	1,051 42
Amount (estimated) required for completion of works indicated	15,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887	15,000 00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

W 6.

PRELIMINARY EXAMINATION OF NISHNA-BOTNA [NISHNABOTANA] RIVER, WITH A VIEW TO INCREASING THE DEPTH OF CHANNEL IN THE MISSOURI RIVER.

UNITED STATES ENGINEER OFFICE,
Saint Louis, Mo., October 17, 1884.

SIR: In accordance with instructions of July 31, I have caused a preliminary examination to be made of the "Nishna-botna River, with a view to increasing the depth of channel in the Missouri River."

All the facts connected with this matter were fully set forth in my report of March 31, 1882, published in the Annual Report of the Chief of Engineers for 1882, page 1736. In order to ascertain whether anything new had been developed since that date I sent my assistant, Mr. L. E. Cooley, to Hamburg, Iowa, to examine into the situation, and his report is appended. From the information thus obtained I conclude that no effect is likely to be produced on the Missouri River in this vicinity in the way of increasing channel depth by any work carried out on the Nishna-botna, and that no interests of commerce are likely to be benefited by such work, the whole question being purely one of damage from overflows during floods of the Missouri and its tributary, the Nishna-botna. Hence the improvement cannot, under the law, be recommended, and no further survey seems necessary.

Very respectfully, your obedient servant,

CHAS. R. SUTER,
Major of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

REPORT OF MR. L. E. COOLEY, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Saint Louis, Mo., September 15, 1884.

MAJOR: I have the honor to report that in accordance with your verbal instructions I visited Hamburg, Iowa, on the 12th instant, to ascertain the intent of the following clause in the river and harbor bill: "Nish-na-botana River, with a view to increasing the depth of channel in Missouri River, Missouri;" also, to make any preliminary examination that might be required to enable you to decide whether the object sought was one worthy the attention of the Government, and, if so, the cost of the necessary surveys to carry out the intent of the above clause.

I found that if part of the clause previously quoted had been written thus: "the depth of channel near the Missouri River," or, "the depth of the old channel of the Missouri River," in place of "the depth of channel in the Missouri River," it would have expressed the desire of the interests concerned. Of course the actual reading is absurd.

The examination of Assistant J. W. Pearl, in the winter of 1882, and the report thereon, Senate Ex. Doc. 155, Forty-seventh Congress, first session, defines the actual situation in great detail and completeness. As a result, the views of those most interested are in substantial accord therewith, and they look for relief now through an amelioration of the present channel, to consist of an improvement of the old cut-off bed in connection with some changes in the proper channel of the Nishna from the Narrows to Hamburg, or in connection with a new route for the Nishna from Hamburg, via Willow Slough, to a point on the old cut-off bed above the Narrows. I present such additional facts as bear on the present situation and my conclusions in the matter.

Before the Missouri and the Nishna united at the Narrows in 1858, low water in the Nishna was about 7 feet lower than low water in the Missouri opposite, and high water, as judged by relative bank height, about 3 feet lower. I do not learn that any special trouble was experienced between 1858 and 1867, the year of the Peru Cut-off, and, also, the year that the railway damaged the old channel of the Nishna. The cut-off lowered high water at the Narrows 6 feet at once, which certainly was an improvement over any condition that previously obtained. An eminently satisfactory condition of affairs prevailed for nine years, or until 1876, since which time an increasing amount of trouble has been experienced, culminating in the high water of 1881. Since 1881 the fall from Hamburg to the Narrows, in the Nishna proper, has increased and a somewhat bettered condition of affairs is recognized.

There seems to be ample evidence that high water or overflow has increased all the way to the Forks, about 9 miles, in a direct line, above Hamburg, and even as high up as Riverton, since 1876. At the same time high water in large volumes has escaped by Willow Slough to the prairies west of Hamburg, and a channel is beginning to work back from the old cut-off bed above the Narrows. This action is being aided to afford an independent drain to the prairies above, and, in time, unless prevented, flood volume of the Nishna will elect this route in preference to the longer and more tortuous river channel. Willow Slough is said to have shown signs of enlargement in recent years, and water is now, at low water, backed into sloughs and areas that formerly ran dry.

A judicious series of cut-offs has been talked of. As the stream has a developed length of about two and a half times that of its bend-belt, the opportunity for a large ratio of shortening is presented. As this is chiefly agitated above Hamburg, the people there realize that the relief experienced above would more quickly precipitate the floods upon them beyond their power to counteract it by cut-offs below, as the real trouble lies in the old bed of the Missouri. So the problem with them readily reduces to restoring in part the efficiency of the old cut-off bed as a drainage channel coupled with a shorter route for flood waters, either by shortening the old channel, which is most feasible, or by a new route via Willow Slough. In this connection there is much complaint of the railway bridge as an obstruction to flow, on account of its pier in mid-channel.

As there is no evidence to show that flood-height in the Missouri has increased from the data collected by Assistant Pearl, and also on this trip it is apparent, as pointed out in Assistant Pearl's report, that the difficulty is due to the silting up of the old bed of the Missouri, and that as this bed is reclaimed and the Nishna defines its channel through it, the condition of affairs will improve. The effect of this bed on the Nishna floods is, no doubt, to increase them several feet, but it is very probable that the maximum effect was reached in 1881, and that the improvement already noticed will continue. The problem is not complicated by overflow of the Missouri above Hamburg, as, in ordinary years, this water is now shut out, and, practically, the old bed north of McKissock's Island has been closed since 1881.

As shown by the low-water profile of Assistant Pearl, the principal part of the fall is concentrated in the first 2 miles near the Missouri River. This is no doubt due to the Missouri, perhaps in part to overflow across the lower end of McKissock's Island, and in part to direct inflow from the mouth. This deposit is said to contain much sand not found in the Nishna deposits.

That the Nishna will in time define its channel through the increasing deposits is self-evident, and when the old bed is reclaimed and that action completed the flood-height at the Narrows will be lowered by an amount equal to that produced by the Peru Cut-off, less the natural fall of the Nishna, in a proper channel for 5 miles above its mouth. This would probably reproduce about the condition as to flood height existing previous to 1858 at and above the Narrows. Natural action could be hastened and some immediate relief afforded by artificial works, which would at once restrict the Nishna in this part of its course to a normal width. As the current is very

small, and there is little or no drift to contend with, frail structures, sufficient only to determine the place of deposit, would be sufficient. Such structures can be made of wire and such material as exists in abundance on the grounds, and would cost about the same as a fence, or say, $1 per rod, and the length of such structures would probably not exceed twice the length of the channel improved. Judging by the profile, about 2 miles of channel would require treatment at present, and ultimately, perhaps, the entire 5 miles to the Narrows. Of course such work would be subject to many contingencies and require much renewal and repairs until the stream was fully defined, but it does not occur to me that the benefits to be realized would justify a more expensive method. This plan, followed up for three or four years, coupled with the alteration of the railway bridge and some shortening of the stream to Hamburg, I do not doubt would accomplish the purpose sought.

The examination required to disclose the validity of these views would be to determine the present profile from Hamburg to the mouth, and a detailed survey with a full set of cross-sections of the old bed of the cut-off. An assistant, after gathering from local surveyors such facts as they may have collected, could probably make this examination with the aid of a rodman and three axmen in a week's time.

Assistant engineer, one month	$125 00
Rodman, ten days	30 00
Three axmen and oarsmen, six days	27 00
Traveling expenses	40 00
Team expenses	28 00
Total examination and report	250 00

I ascertained that in former times the old bed of the Nishna below Hamburg was navigated by steamers, but they had no occasion to come to Hamburg, as the Missouri landing was within 3 miles. The river above Hamburg has not been navigated, although the land surveys defined it as a navigable stream as far as the Forks. The character of the stream is certainly adapted in a high degree to navigation by a small class of steamers. Its course is well defined, its banks are stable, and cross-section economical; a good depth exists on the crossings, and the country about is very productive. Its drainage area is double, and its low-water discharge treble that of many well-known streams which receive the fostering care of the General Government. To make it available will require the cutting of overhanging trees, a limited amount of snagging, and the alteration of existing bridges. At some time its merits will invite attention. At present the channel in Peru bend, without improvement, could not be run.

A small steamer, able to pass the bridges at a moderate stage, has just been built at Hamburg. Its dimensions, or the purpose of the owners, I did not learn.

The general plan proposed would harmonize and satisfy all interests. The present benefits would probably be solely to landed and corporate interests, as the interests of navigation are quite undeveloped. The justification for an improvement would necessarily rest in the opening out of a stream of much intrinsic merit as a navigable channel. If legislation should have this in view it should also make provision for altering bridges and removing the overhanging trees and a few snags.

Very respectfuully, your obedient servant,

L. E. COOLEY,
Chief Assistant.

Maj. CHAS. R. SUTER,
Corps of Engineers, U. S. A.

W 7.

PRELIMINARY EXAMINATION OF KANKAKEE RIVER, INDIANA.

UNITED STATES ENGINEER OFFICE,
Cincinnati, Ohio, November 4, 1884.

GENERAL: In accordance with instructions contained in your letter of September 4, 1884, I have the honor to submit a report of the preliminary examination of the Kankakee River, Indiana.

The examination of this river was intrusted to Mr. A. L. Duvall, assistant engineer, whose report is forwarded herewith.

The Kankakee River rises in the northern portion of Indiana. It flows in a southwesterly direction, draining an area of about 1,600 square

miles in that State, which is for the most part an unreclaimed marsh. From Indiana it passes into Illinois, where it receives the waters of the Iroquois River, and, taking a northwesterly direction, joins the Des Plaines River, forming with it the Illinois River. It is about 313 miles in length, of which about 242 miles are in Indiana, according to the survey of Father Joseph A. Stephan, formerly the chief engineer of the Kankakee Valley Draining Company, and the remaining 71 miles in Illinois.

From its mouth to Warner's Landing, a distance of about 33 miles, the river has been improved by the construction of four locks and dams, giving slackwater navigation, which enabled the commerce of the river to reach the Illinois and Michigan Canal. Three of these locks and dams were built by the Kankakee Company, which no longer has control of the river, having failed to comply with the terms of its charter, and no tolls have been collected by the company since 1882. The remaining lock and dam was constructed by the State of Illinois.

Above the head of the present slackwater navigation to about 2 miles beyond Momence, a distance of 36 miles, the fall in the river is 73.82 feet. (See report of Maj. J. A. Smith, Report of Chief of Engineers, 1880, page 1845.) This portion is obstructed by five mill-dams, one at Altorf, one at Kankakee, one at Waldron, and two at Momence. These are all fully described by Mr. Duvall.

In the report of Major Smith referred to a project was submitted for the improvement of this section of the river, at an estimated cost of $550,000. It was proposed to construct seven locks, with nearly 12 miles of canal, and remove such obstructions as were necessary, thus extending slackwater to Momence.

In a preceding report submitted by Major Smith (see Report of Chief of Engineers, 1879, page 1455) a description of the river for 120 miles above Momence, to Baum's Bridge, is given, and it is there stated that during the low-water season the river for this distance is navigable for small light-draught steamers. The depth of the water ascertained by Major Smith was generally 5 feet or more, and nowhere was the depth found to be less than 2 feet. It is presumed that this distance did not include the natural rock bar at Momence, upon which there were 1½ feet of water during the recent examination, as it was learned that it was usually dry during the season of low water. As near as could be ascertained the object of the present examination was the removal of this rock bar. It was advocated for the purpose of allowing the passage of steamers. Two or three small steamers in former years were running between Momence and the upper river, but they are not now in use, and have been dismantled, and there has been no river commerce from Momence, above or below, during the past two years.

The removal of this bar was discussed in the report of Major Smith, contained in Senate Ex. Doc. No. 30, Forty-eighth Congress, first session, and in this he gives a complete description of it. It is as follows:

From a map of the river at Momence I have constructed a longitudinal section in the channel, covering a distance of 12,400 feet, about 2⅓ miles.

The bottom of the stream over this distance is entirely of limestone, the surface of which is somewhat irregular and broken, showing it to be in layers or strata, some of which are but a few inches in thickness.

The highest point of the formation in the river bed is directly opposite the upper end of the upper dam at Momence; the altitude of the stone at this point is 4½ feet higher than where it first appears, 4,800 feet up-stream, and it is 9½ feet higher than where it is again covered, at a distance of 7,600 feet down-stream.

It will be seen that the stone formation is a barrier maintaining the water at a greater depth than would otherwise obtain, thus aiding, rather than injuring, the navigation above.

The distance from the present head of slackwater navigation to Momence is 35

miles, and the difference of level is over 70 feet. It will be readily seen that the removal of a barrier 35 miles above the head of navigation cannot improve or extend that navigation in any way; but by permitting the drainage of the pool above, such a removal would add materially to the difficulty of extending the navigation at any future time.

It is estimated in the report of Mr. John L. Cambell, chief engineer, made to the governor of the State of Indiana in 1882, that about 400,000 acres of exceedingly rich land could be reclaimed from the marshes along the Kankakee River and its tributaries by judicious drainage. The removal of the bar would undoubtedly aid in draining these marshes and thus help materially the agricultural development of the locality.

Since it appears that there is little or no commerce to be benefited by the removal of this bar, and that it may even be detrimental to such navigation as there is, this river cannot be said to be "worthy of improvement" as proposed, if commerce be alone considered. If, however, agricultural development is to be taken into account, then it may be regarded "worthy of improvement."

As the surveys that were made in former years, together with the preliminary examination just made, have given sufficient data to form a correct judgment of the benefits to be derived from this improvement, no estimate for further survey is made.

Very respectfully, your obedient servant,

JAS. C. POST,
Captain of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

REPORT OF MR. A. LESLIE DUVALL, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Cincinnati, Ohio, November 4, 1884.

SIR: I respectfully submit the following report of an examination of Kankakee River, Indiana and Illinois:

I examined the river particularly at and near Momence, Ill., as, according to a letter from Hon. Thomas J. Wood, M. C., Crown Point Ind., dated August 8, 1884, that was the locality where the improvement was desired. I also examined the river below, at and near Waldron, 12 or 13 miles below Momence, and on to Kankakee, about 5 miles below Waldron or Aroma, and below Kankakee.

About 1¼ miles above Momence is the highest part of the natural rock bar or dam through which it is desired to cut a channel; this bar or dam is limestone in strata or layers, in some instances only 2 or 3 inches thick. The banks of the river at and near Momence are low and flat, particularly so above that point, where I think they are not over 15 feet above the lowest water; farther up in Indiana the marshes begin, and a rise of about 8 feet will flood the lands for from 3 to 5 miles each side of the river. Below Momence the banks gradually get higher down to Waldron, and so on to Kankakee, and from thence down are well defined, and range from about 25 to 35 feet above low water. There have never been any overflows below Momence that I could hear of. There are ten dams on this river from Momence to its mouth; two at Momence, the upper one 3 feet, and the lower one (which leaks considerably) 7 feet high, built under authority granted by State of Illinois February 10, 1837. The one at Waldron, 6½ feet high, was built in 1853, by E. R. Beardsley, without any authority from the State, as far as I can ascertain; but he owned the land on both sides of the river.

The dam at Kankakee, 8 feet high, was built in 1859 by Dickson and Dean, and, as far as I could learn, without authority from the State, they owning both shores; the present owner is James McGrew, of Kankakee. This dam backs water up to Waldron, about 5 miles above, and a small side-wheel steamboat, 74½ feet long, 12½ feet wide, and drawing about 3 feet when loaded, navigates the pool from Kankakee to Waldron.

There was a dam at Altorf, 7 miles below Kankakee, about 6 feet high, which backed the water up for 3 miles; it was nearly destroyed by ice about eight years ago, and has never been repaired; there is hardly a vestige of it remaining; it was built about 1860, and, as far as I can find, without authority from the State, by David Denny, who owned both shores; the present owner of the site is Hiram Goodwin, of Altorf.

The dams of the Kankakee Company were built by authority of the State of Illinois, under charter granted to Kankakee and Iroquois Navigation and Manufacturing Company in 1847, and are as follows, viz:

Dam No. 4 (upper dam), at head of Alden's Island, Wilmington, Ill., is 1,000 feet long and 16 feet high; there is a solid masonry lock here, 15 feet lift.

Dam No. 3, Wilmington, across main branch, south side of island, is a low mill-dam.

Dam No. 2, Wilmington, at foot of Alden's, Island is 11 feet high, with masonry lock 10½ feet lift.

Dam No. 1, 4 miles below Dam No. 2, at Wilmington, is 8½ feet long, 12 feet high, and is built of solid masonry, with masonry lock of 8 feet lift.

The State dam, three-quarters of a mile below Dam No. 1, is 950 feet long, with masonry lock which connects with feeder of Illinois and Michigan Canal. This system of slackwater extends up to Warner's Landing, 12 miles above Wilmington, a distance of 33 miles from the mouth of the river. Twenty-one miles of this were completed by the Kankakee Company, and the remainder by the State of Illinois. The company has given up the control of the river since 1882, although it still claims a race passing through its lands from Pool No. 4, three-quarters of a mile long, 100 feet wide at surface, and 8 feet deep when the pool is full.

Dam No. 4 was injured by ice in spring of 1883, and slight repairs have been made by individuals to keep up water power. The locks have been used for the passage of boats since 1882, and can be used at the present time, but require repairs. Above Momence, or rather above the rock bar mentioned, the river is said to be navigable for small steamboats (see report of Maj. Jared A. Smith, U. S. Engineers, in report of Chief of Engineers for 1879, page 1455), and in report on preliminary examinations (see Senate Ex. Doc. No. 30, Forty-eighth Congress, first session, page 96), up to Baum's Bridge, a distance of 120 miles. There are two mill-dams (described above) below the rock-bar, draining channels on each side of an island; these dams seem to back water over the crest of the rock-bar, where, on Friday, October 24, I found about 1½ feet of water; but the wind was blowing a gale up the river, and probably in connection with the downward current banked the water higher at that point than it would have been on a calm day. I was informed that the higher portion of this rock-bar is bare at low water. There is a railroad bridge over the river about three-quarters of a mile below the rock-bar and a highway bridge at Momence; the railroad bridge is about 12 feet and the highway bridge about 20 feet above the water. The bridges crossing the river below this point are generally not less than from 25 to 30 feet above low water. The highest water at Momence rises about 10 feet, but from Waldron down the rise in high water is not over 8 feet. From all the information I could get on the subject by conversation with many of the principal citizens of the Kankakee region, among whom were Hon. Thomas J. Wood, Crown Point, Ind.; Mr. W. F. Singleton, Shelby, Ind.; Mr. J. P. Stratton, Grant Park, Ill.; Mr. Worcester, cashier of bank at Momence; Dr. Keyser and Mr. J. L. Clark, C. E., also of Momence; and Mr. Charles Holt, editor of the Kankakee Gazette: Mr. James Mix, Judge James N. Orr, Mr. John K. Crosswell, C. E., and Mr. Stephen R. Moore (to whom I am indebted for very important and reliable information), all of Kankakee, I believe that the further improvement of the Kankakee River by a slackwater system up to Momence would be of great benefit and convenience to the surrounding country, as it would afford an outlet for its productions independent of the railroads. There is no commerce on the Kankakee from Momence above or below at present, and has not been for about two years on the river above, where two or three small steamboats used to carry supplies up the river, but are not now in use; one is on shore a short distance below the top of the rock-bar, without boilers or engines, and the wreck of another lies at south end of the railroad bridge over north channel. I append hereto a list of the principal productions of Kankakee County, Illinois, in which Momence is situated, the majority of which products, I suppose, would be shipped by the river if navigable.

The principal object in view by the persons desiring the improvement asked above Momence (as far as I can learn by careful inquiry) is the drainage of the Kankakee swamp lands.

Very respectfully, your obedient servant,

A. LESLIE DUVALL,
Assistant Engineer.

Capt. JAS. C. POST,
Corps of Engineers, U. S. A.

Principal products of Kankakee County, Illinois, with values, for year 1883.

[Compiled from Circular No. 106 of Department of Agriculture, dated Springfield, Ill., December 31, 1883.]

Products.	Quantities.	Values per unit of measure.	Gross values.
Corn ..... bushels..	1, 610, 200	$0 40	$644, 080
Rye ..... do....	135, 000	50	67, 500
Wheat ..... do....	60, 000	1 00	60, 000
Clover-seed ..... do....	8, 178	5 00	40, 890
Potatoes ..... do...	164, 290	60	98, 574
Apples ..... do....	20, 000	1 00	20, 000
Butter ..... pounds..	453, 000	20	90, 600
Beef cattle ..... do....	5, 407, 500	05	270, 375
Hogs ..... do....	3, 979, 800	04	159, 192
Sheep ..... do....	126, 100	05	6, 305
Wool ..... do....	21, 500	20	4, 300
Total value	.....	.....	1, 461, 816

No manufactures of any account noted; total acres in county, 421,184; total acres under cultivation, 151,370; percentage of land under cultivation, .32.

W 8.

PRELIMINARY EXAMINATION OF WABASH RIVER, INDIANA, FROM LOGANSPORT TO DELPHI.

UNITED STATES ENGINEER OFFICE,
Cincinnati, Ohio, November 3, 1884.

GENERAL: In accordance with instructions contained in your letter of July 31, 1884, I have the honor to submit a report upon the preliminary examination of the "Wabash River from Logansport to Delphi, Ind."

The examination of this river was given to Mr. A. L. Duvall, assistant engineer, whose report is forwarded herewith.

The Wabash River, from Delphi to Logansport, a distance of 23 miles, is a broad stream, varying from 600 to 900 feet in width, with comparatively low banks. Above Delphi about 1 mile, at Pittsburgh, the remains of an old dam obstruct the river. This was built originally 13 feet high, and was constructed by the State of Indiana in 1837 to form the Upper Wabash into a feeder for the Wabash and Erie Canal. It gave slackwater for a distance of 6 miles to Carrollton, where the canal enters the river, and the river between this place and the dam, where the canal leaves it, formed a part of the water-way of the canal. This canal has not been in use for a number of years, owing no doubt to the competition of the railroads which are now carrying nearly all the commerce in this vicinity. The dam, however, has been kept up as a source of water-power until about four years ago, when it was destroyed by some unknown persons. Since then no attempt has been made to rebuild it. Above Carrollton Mr. Duvall estimates the slope of the river to be about 1 foot to the mile for a distance of 8 miles. From this point to Logansport there are rapids upon which he estimates the slope to be 3 feet to the mile, and he states that the total fall from Logansport to Delphi, as near as he could ascertain without the use of an instrument, was 40 feet, which is an average of about 1.7 feet per mile. This, of

course, is simply an approximation, but still it is sufficient to show that no effective improvement of this section of the river could be made by any other means than that of slackwater, and that this would probably require the construction of at least three locks and dams. From the information obtained there seems to be little or no commerce upon this portion of the river, nor has there been for a number of years, although the statistics of the two adjoining counties, inclosed herewith, place the value of their productions at nearly $7,500,000 for the year 1882.

The Government for several years past has been engaged in improving the Wabash River from Terre Haute to its mouth, and with the completion of the works now proposed this portion of the river will be navigable for boats of large size in all seasons except during that of extreme low water. Terre Haute is about 123 miles by river from Delphi, and the portion of this distance included between Terre Haute and Lafayette is at present so obstructed by bridges that without their modification it cannot be made navigable, except for small craft. This condition of the river below Delphi practically isolates the section included between Logansport and Delphi, which is also obstructed by bridges, and any improvement made in the interest of navigation between these places will not only be limited in its effect upon the local commerce by the presence of the bridges in the immediate vicinity, but will add little or nothing to the commerce of the lower river, because of the restriction imposed by the bridges below La Fayette.

Taking all the facts as ascertained into consideration, it does not seem that under the present conditions the probable increase of commerce which would result from the improvement of the portion of the river between Logansport and Delphi would be sufficient to justify the expenditure. It is therefore not considered "worthy of improvement," and no estimate is submitted for further survey.

Very respectfully, your obedient servant,

JAS. C. POST,
Captain of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

REPORT OF MR. A. LESLIE DUVALL, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Cincinnati, Ohio, October 30, 1884.

SIR: I respectfully submit the following report of an examination of the Wabash River, from Logansport, Ind., to Delphi, Ind. I examined the river at and between the points named. The river near Logansport is about 600 feet wide, with flat, rocky bed (limestone), and gravelly banks; opposite the town is an island about 400 feet wide and 1,000 feet long; the Eel River empties into the Wabash at Logansport, and the town, containing between 16,000 and 17,000 inhabitants, is built on the point between the two rivers. Below the mouth of Eel River the Wabash varies from 600 to 700 feet in width down to Delphi, a distance of about 23 miles. The flat, rocky bottom extends down-stream from Logansport for about 8 miles, or a little below Georgetown, Ind.; thence on the river has sand and gravel bottom. There is a portion of a dam at Pittsburgh, a little over a mile above Delphi; this dam was built in 1837 by the State of Indiana for the Wabash and Erie Canal, forming a basin for boats above it, and feeding the canal below, which departed from the river near the dam; it also furnished power to several mills and factories at Pittsburgh. The canal having become inoperative, the dam was kept up for the purpose of furnishing water-power, and about four years ago was partially destroyed by dynamite and rendered useless by some persons unknown; this dam, 13 feet high, made available slackwater up to a place called Carrollton, about 6 miles above it, were the canal entered the river. The fall of the river from Logansport for about 8 miles down is considerable, and I

think it to be about 3 feet to the mile; below this point the slope is more gentle and probably not more than 1 foot to the mile, making a total fall of about 40 feet; this is as near as I can estimate it without the use of an instrument.

There are five bridges at Logansport and six between that place and Delphi, the majority of which are not over 20 or 22 feet above low water, or zero. The highest water at or near Logansport is not over 13 feet above zero, as the river is wide, and having considerable fall above and below this point the water runs off rapidly.

There has not been any commerce of any account on the Wabash River between Logansport and Delphi for nearly thirty years, the river being used only by an occasional flat-boat descending and by timber rafts, &c.; the carrying trade of the Upper Wabash Valley is now done entirely by the railroads. There was an examination of this river made in 1870 (see report of Col. G. Weitzel, United States Engineers, in Report of Chief of Engineers of 1871, page 485) from Wabash Town, about 30 miles above Logansport, to its mouth. Colonel Weitzel in his report recommended that a survey be made from La Fayette down, but did not contemplate extending it above that point. Up to the present time there have been no surveys above Terre Haute, Ind., and no money spent for improvement above that place.

I append hereto a list of the principal productions of Cass and Carroll counties, Indiana, in which are situated the towns of Logansport and Delphi, the greater portion of which products would naturally seek an outlet by way of the river if navigable; but the local traffic between Logansport and Delphi is not very great.

Delphi has a population of about 2,500. From conversation with many of the principal citizens of Logansport and Delphi and surrounding country, among whom I will mention Judge Horace P. Biddle, Mr. B. F. Louthain, and Mr. Daniel Tomlinson, of Logansport, and Mr. Rhinehart, Dr. Angel, and Rev. Mr. Braddon, of Delphi, I am of the opinion that this detached portion of the Wabash, from Logansport to Delphi, if improved, would not be of much importance except to the owners of the mills and factories at Pittsburgh, where, if the dam were restored at that place, there would be abundant water power available.

From an examination of the railroad statistics in the fifth annual report of the Indiana bureau of statistics I find that the Wabash, Saint Louis and Pacific Railroad, the only railroad which connects Logansport and Delphi, is assessed, on the distance between the points named, by the counties of Cass and Carroll, to the extent of $329,813, but I cannot get any reliable statistics as to the local traffic between those places, other than from general information from leading citizens heretofore referred to.

Very respectfully, your obedient servant,

A. LESLIE DUVALL,
Assistant Engineer.

Capt. JAMES C. POST,
Corps of Engineers, U. S. A.

Principal products of Cass County, Indiana, with values for the year 1882.

[Compiled from the annual report of the Indiana bureau of statistics, dated Indianapolis, October 31, 1883.]

Products.	Quantities.	Value per unit of measure.	Gross value.
Corn ..... bushels..	1,266,470	$0 40	$506,588 00
Wheat ..... do....	527,969	1 00	527,969 00
Oats ..... do....	172,134	30	51,640 20
Barley ..... do....	1,140	30	342 00
Potatoes ..... do....	162,130	60	97,298 00
Flax-seed ..... do....	8,114	1 00	8,114 00
Hay ..... tons..	14,197	5 00	70,985 00
Maple sugar ..... pounds..	1,200	10	120 00
Butter ..... do....	255,623	20	51,124 60
Cheese ..... do....	1,810	20	362 00
Hogs ..... do....	4,884,945	04	195,397 80
Beef cattle ..... do....	1,200,000	05	60,000 00
Sheep ..... do....	180,000	05	9,000 00
Wool ..... do....	70,500	20	14,100 00
Poultry ..... dozen..	4,500	1 00	4,500 00
Total value of manufactured articles	.....	.....	4,006,443 00
Grand total	.....	.....	5,703,983 60

Principal products of Carroll County, Indiana, with values for the year 1882.

[Compiled from the annual report of the Indiana bureau of statistics, dated Indianapolis. October 31, 1883.]

Products.	Quantities.	Value per unit of measure.	Gross value.
Corn ..... bushels..	1,185,044	$0 40	$474,017 60
Wheat ..... do....	462,536	1 00	462,536 00
Oats ..... do....	165,377	30	49,613 10
Barley ..... do....	5,980	30	1,794 00
Potatoes ..... do....	129,443	60	77,665 80
Flax-seed ..... do....	5,589	1 00	5,589 00
Hay ..... tons..	13,775	5 00	68,875 00
Maple sugar ..... pounds..	1,600	10	160 00
Butter ..... do....	255,623	20	51,124 60
Cheese ..... do....	4,187	20	837 40
Hogs ..... do....	3,958,757	04	158,350 28
Beef cattle ..... do....	1,000,000	05	50,000 00
Sheep ..... do....	120,000	05	6,000 00
Wool ..... do....	48,000	20	9,600 00
Poultry ..... dozen..	4,866	1 00	4,866 00
Total value of manufactured articles	.....	.....	308,295 00
Grand total	.....	.....	1,729,323 78

W 9.

REPORT OF MAJOR CHARLES R. SUTER, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR PART OF THE FISCAL YEAR ENDING JUNE 30, 1885.

UNITED STATES ENGINEER OFFICE,
Saint Louis, Mo., September 3, 1885.

GENERAL: I have the honor to submit herewith my annual report on the works under my charge during the year ending June 30, 1885.

Very respectfully, your obedient servant,

CHAS. R. SUTER,
Major of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

REMOVING SNAGS AND WRECKS FROM MISSISSIPPI AND MISSOURI RIVERS.

MISSISSIPPI RIVER.

Work on this stream while under my charge extended from Saint Louis, Mo., to Glasscock's Island, a distance of 925 miles. The snag-boats Macomb and Wright were employed.

The Macomb left Saint Louis August 12, and worked down-stream as far as Glasscock's Island, Louisiana, which point was reached September 25. She then returned, working up-stream, to the vicinity of Saint Louis by October 31.

During the greater part of November this boat was engaged on special duty near Elmot, Ark., for the Mississippi River Commission, who paid her expenses. On November 22 she left Elmot for Helena, Ark., and worked down-stream from that point till the close of the month.

The Wright having completed her summer's work in the Missouri River was detailed, November 1, to the Mississippi. She began work

at Saint Louis, and by the end of the month was at Mhoon's Landing, 49 miles below Memphis.

At the end of November the work was turned over to Maj. A. M. Miller, Corps of Engineers, U. S. Army.

Table of work done in Mississippi River.

Name of boat.	Snags pulled.	Weight, in tons of 2,000 pounds.	Trees cut.	Drift piles removed.	Miles run.
J. N. Macomb	1,006	16,056.8	353	14	2,505
H. G. Wright	291	6,428.2	1,489	.....	501
Total	1,297	22,485.0	1,842	14	3,006

Money statement.

July 1, 1884, amount available		$900 23
Amount allotted from appropriation by act approved July 5, 1884		60,000 00
Received by transfer from Major Mackenzie		12,950 63
		73,850 86
Amount expended to November 30, 1884, exclusive of outstanding liabilities	$13,763 99	
Amount of outstanding liabilities turned over to Major Miller for payment	6,512 98	
		20,276 97
December 1, 1884, balance available		53,573 89

MISSOURI RIVER.

Work on this stream was done by the snag-boat Wright and extended from the mouth to Kansas City.

The Wright entered Missouri River August 10, and had worked up to Kansas City by September 26. She then turned back and worked down to the mouth of the river. She reached Saint Louis by the end of October and was then detailed for work on the Lower Mississippi.

November 22 this work was turned over to Maj. A. M. Miller, Corps of Engineers, U. S. Army.

Table of work done in Missouri River.

Name of boat.	Snags pulled.	Weight, in tons of 2,000 pounds.	Trees cut.	Drift piles removed.	Miles run.
H. G. Wright	1,042	14,609.9	1,353	10	918

Recapitulation of work done.

Names of rivers.	Snags pulled.	Weight, in tons of 2,000 pounds.	Trees cut.	Drift-piles removed.	Miles run.
Mississippi	1,297	22,485	1,842	14	3,006
Missouri	1,042	14,609.9	1,353	10	918
	2,339	37,094.9	3,195	24	3,924

Money statement.

July 1, 1884, amount available	$81,664 75
Amount appropriated by act approved July 5, 1884	50,000 00
	131,644 75
November 22, 1884, amount expended to this date	13,872 63
November 22, 1884, balance available	117,772 12

IMPROVEMENT OF MISSOURI RIVER FROM ITS MOUTH TO SIOUX CITY, IOWA.

Operations under this head were confined to office-work, repairs, and care of plant and reading and maintaining water-gauges until such time as the Missouri River Commission could perfect its organization and take charge of the work.

The small balance of the old appropriation was used in this work.

Money statement.

July 1, 1884, amount available	$33,819 12
Amount received from sale of fuel to officers	45 36
	33,864 48
Amount expended to December, 1884	33,864 48

SURVEY OF MISSOURI RIVER FROM ITS MOUTH TO FORT BENTON, MONTANA.

Work was continued upon the maps, &c., of this survey till October 21, when the work was transferred to Lieut. W. C. Fisk, Corps of Engineers, U. S. Army, secretary Missouri Commission.

Money statement.

July 1, 1884, amount available	$10,390 34
October 21, 1884, amount expended to this date	1,545 95
October 21, 1884, balance available	8,844 39

IMPROVEMENT OF GASCONADE RIVER, MISSOURI.

A party was organized for work on this improvement during the month of September, under the charge of Assistant James A. Seddon. They began removing snags from the bed of the stream near Lanesford, September 27. October 15 this work was turned over to Maj. A. M. Miller, Corps of Engineers, U. S. Army.

Money statement.

Amount appropriated by act approved July 5, 1884	$5,000 00
October 15, 1884, amount expended to this date	1,742 43
October 15, 1884, balance available	3,257 57

APPENDIX X

IMPROVEMENT OF MISSISSIPPI RIVER BETWEEN THE MOUTHS OF THE ILLINOIS AND OHIO RIVERS—IMPROVING HARBOR AND MISSISSIPPI RIVER AT ALTON, MISSISSIPPI RIVER OPPOSITE THE CITY OF SAINT LOUIS, AND AT OR NEAR CAPE GIRARDEAU AND MINTON POINT.

REPORT OF MAJOR O. H. ERNST, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1885.

IMPROVEMENTS.

1. Mississippi River between the Illinois and Ohio rivers.
2. Harbor and Mississippi River at Alton.
3. Mississippi River opposite the city of Saint Louis, Mo.
4. Mississippi River at or near Cape Girardeau, Mo., and Minton Point, Ill.

EXAMINATION.

5. Osage River, Missouri, from mouth to Linn Creek, with a view to movable locks and dams.

UNITED STATES ENGINEER OFFICE,
Saint Louis, Mo., July 8, 1885.

GENERAL: I have the honor to transmit herewith the annual reports for the last fiscal year upon the works under my charge.

Very respectfully, your obedient servant,

O. H. ERNST,
Major of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

X 1.

IMPROVEMENT OF THE MISSISSIPPI RIVER BETWEEN THE ILLINOIS AND OHIO RIVERS.

At the date of my last annual report the works were suspended, the appropriation being very nearly exhausted. The river and harbor act of July 5, 1884, provided that the sums therein "appropriated for the Mississippi River, from the Des Moines Rapids to the mouth of the Ohio, shall be expended under the direction of the Secretary of War, in accordance with the plans, specifications, estimates, and recommendations of the Mississippi River Commission," and under date of July 21, 1884, I

was ordered to report to the Commission. A portion of the small balance remaining available at the beginning of the fiscal year had been used in office expenses and in caring for the public property. The remainder was expended under the direction of the Commission. Accordingly no work of construction has been done under the immediate direction of the Chief of Engineers during the year.

The hurdles previously constructed continued to act favorably during the year, causing heavy additional deposits. The progress made in building up the new banks is shown upon Plates I, II, and III, herewith transmitted, the works constructed during the present year, of course, contributing to these results. Plates IV and V show the forms of construction for hurdles and bank protection, respectively, as they were finally perfected, when the works left the hands of the Engineer Department.

Money statement.

July 1, 1884, amount available	$5,354 51
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	5,354 51

X 2.

IMPROVEMENT OF THE HARBOR AND MISSISSIPPI RIVER AT ALTON, ILLINOIS.

Nothing was done here during the year under the direction of the Chief of Engineers. By a provision in the act of July 5, 1884, the supervision of the work devolved upon the Mississippi River Commission.

X 3.

IMPROVEMENT OF MISSISSIPPI RIVER OPPOSITE THE CITY OF SAINT LOUIS, MISSOURI.

Nothing was done here during the year under the direction of the Chief of Engineers. By a provision in the act of July 5, 1884, the supervision of the work devolved upon the Mississippi River Commission.

X 4.

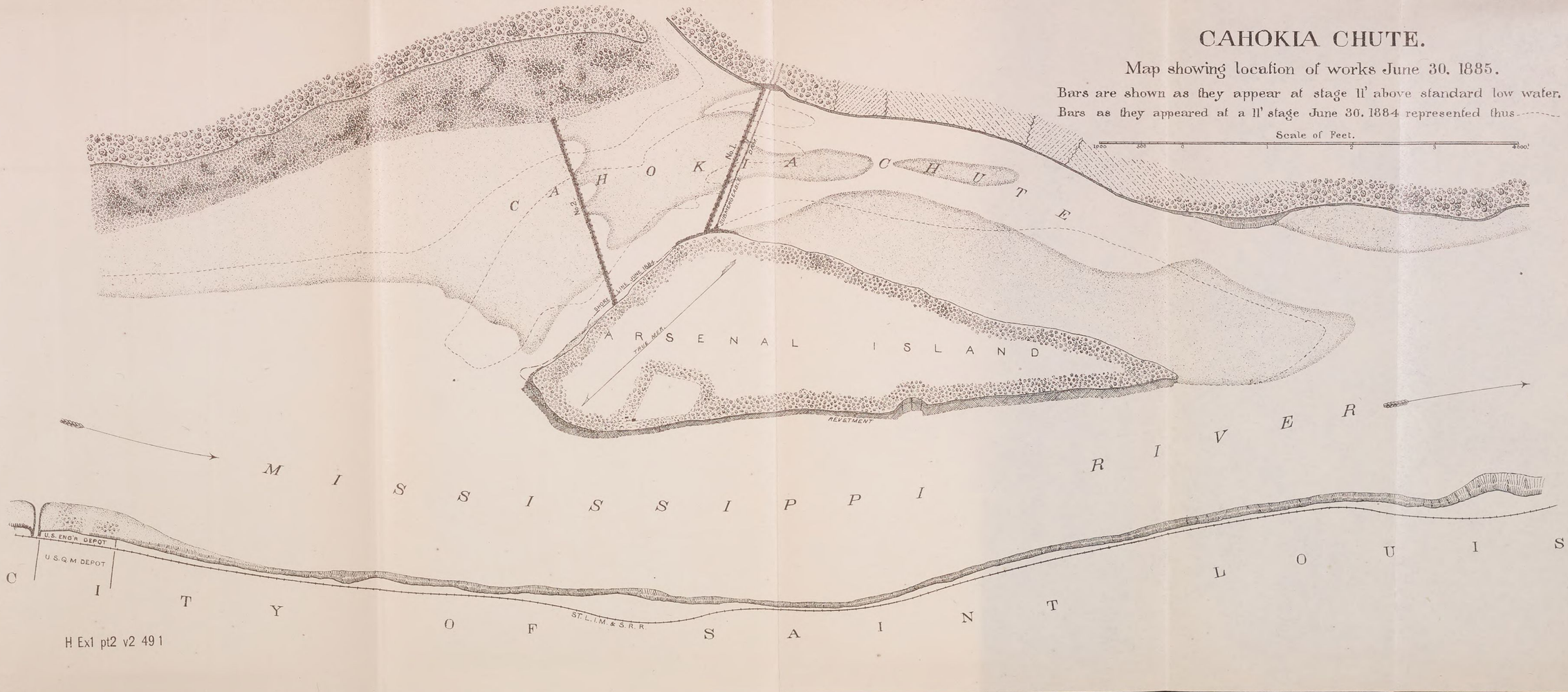
IMPROVEMENT OF THE MISSISSIPPI RIVER AT OR NEAR CAPE GIRARDEAU, MISSOURI, AND MINTON POINT, ILLINOIS.

Nothing was done here during the year under the direction of the Chief of Engineers. By a provision in the act of July 5, 1884, the supervision of the work devolved upon the Mississippi River Commission.

CAHOKIA CHUTE.

Map showing location of works June 30, 1885.

Bars are shown as they appear at stage 11' above standard low water.
Bars as they appeared at a 11' stage June 30, 1884 represented thus.....



H Ex1 pt2 v2 491

Improvement of Mississippi between Illinois and Ohio Rivers. Annual Report of Major O. H. ERNST, Corps of Engineers. 1885.

MISSISSIPPI RIVER.

HORSETAIL.

Map showing location of works June 30th 1885.

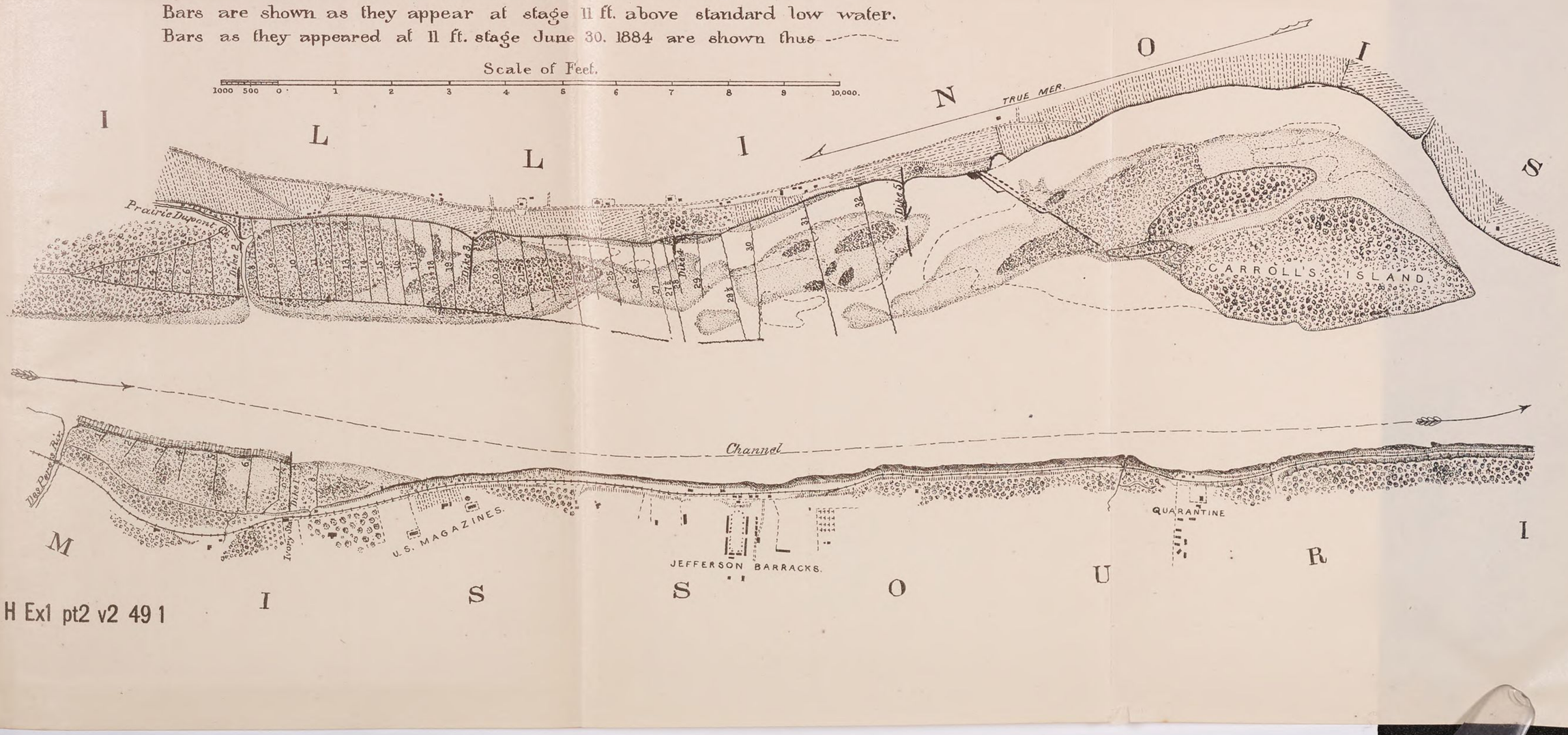
Bank protection, west side, represented thus

Bars are shown as they appear at stage 11 ft. above standard low water.

Bars as they appeared at 11 ft. stage June 30. 1884 are shown thus ----------

Scale of Feet.

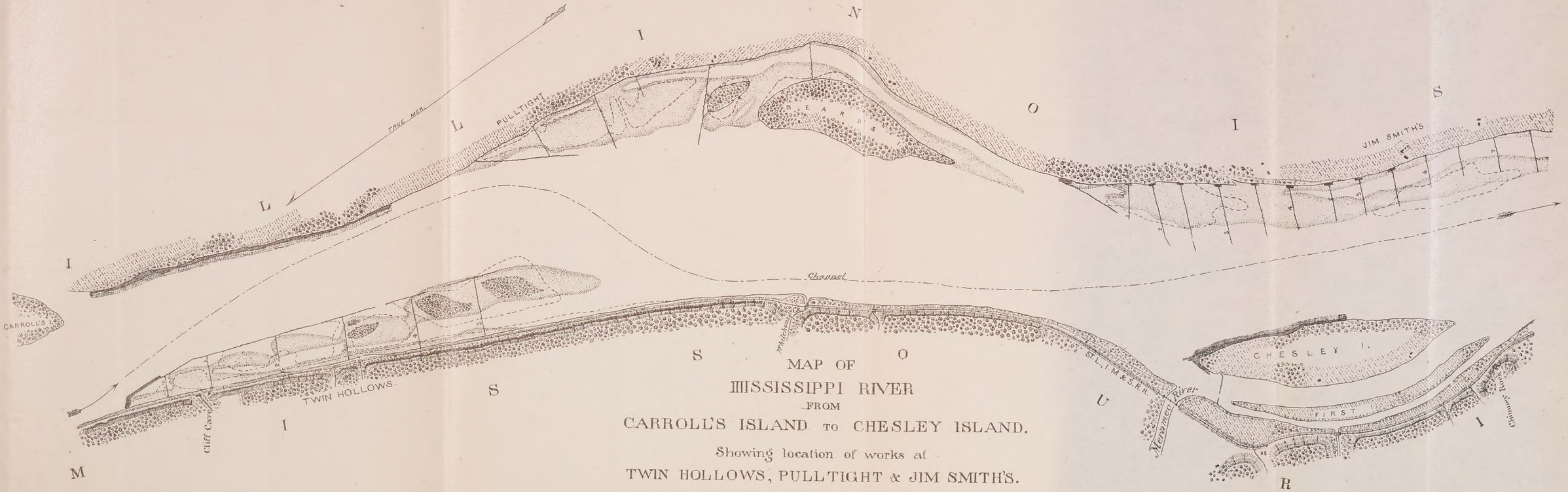
1000 500 0 1 2 3 4 5 6 7 8 9 10,000.



H Ex1 pt2 v2 491

Improvement of Mississippi between Illinois and Ohio Rivers. Annual Report of Major O. H. ERNST, Corps of Engineers. 1885.

PLATE III.



MAP OF

MISSISSIPPI RIVER

FROM

CARROLL'S ISLAND TO CHESLEY ISLAND.

Showing location of works at

TWIN HOLLOWS, PULLTIGHT & JIM SMITH'S.

Bank protection represented thus

Bars are shown as they appear at stage 11 ft. above standard low water.

Bars as they appeared at 11 ft. stage June 30. 1884 are shown thus

Scale of Feet.

3000 500 0 1 2 3 4 5 6 7 8 9 10000.

June 30. 1885.

H Ex1 pt2 v2 491

Improvement of Mississippi River between Illinois and Ohio Rivers.

Major O. M. Ernst,
Corps of Engineers, U.S. Army.
Officer in Charge.

Details of Bundles.

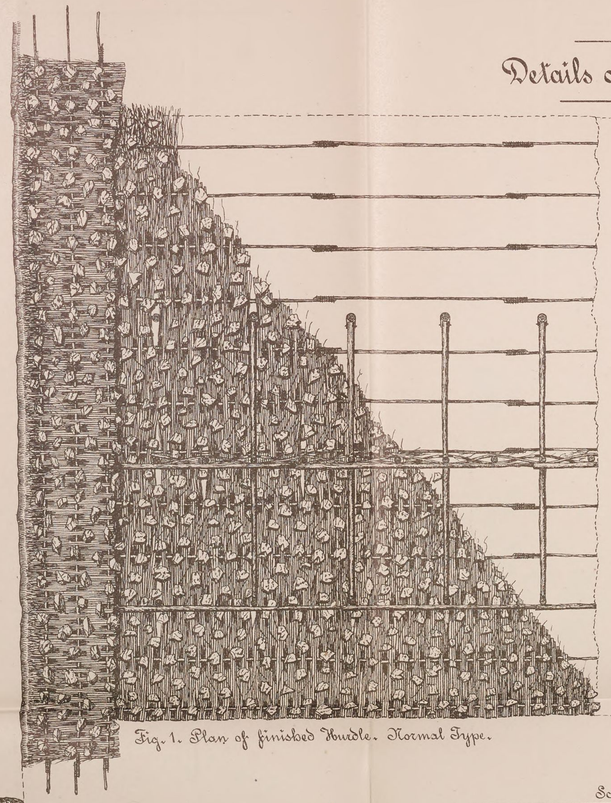


Fig. 1. Plan of finished Bundle. Normal Type.

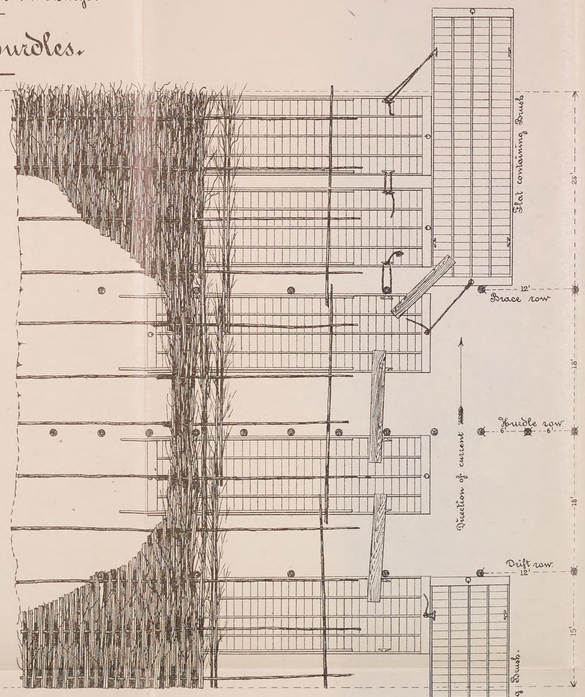


Fig. 3. Plan showing construction of Foundation Mattress.

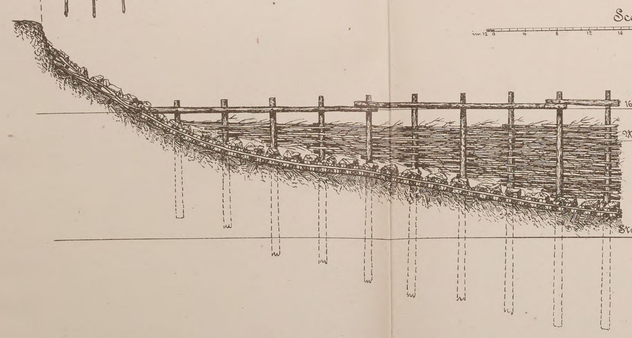


Fig. 2. Upstream side view of finished Bundle. Normal Type.

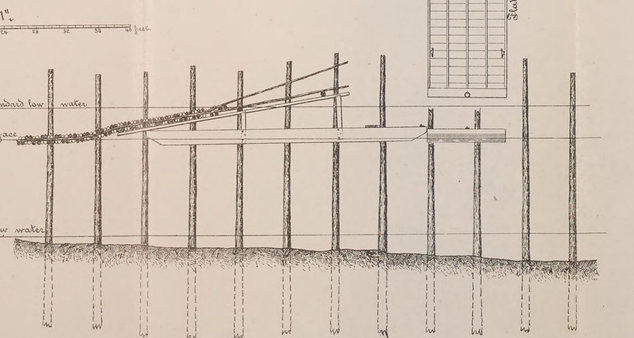


Fig. 4. Upstream side view of Foundation Mattress under construction.

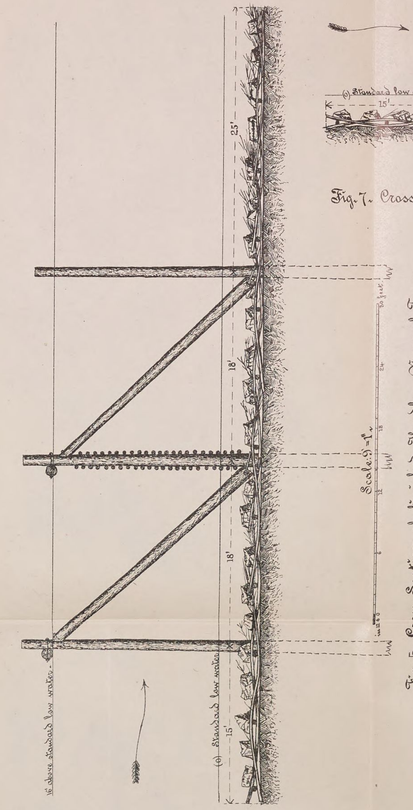
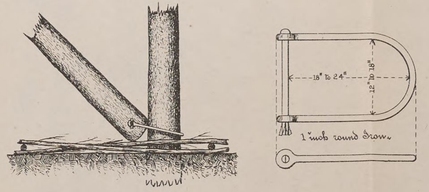


Fig. 5. Cross Section of finished Bundle. Normal Type.



Figs. 8. Clevis for securing the foot of brace-piles.

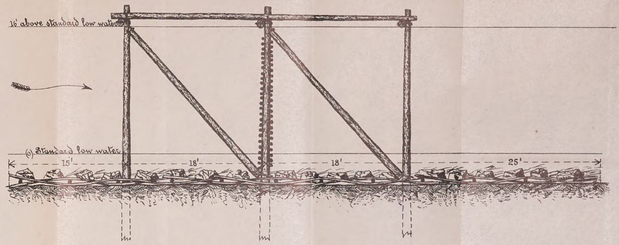


Fig. 7. Cross Section of finished Bundle in swift current or depths greater than 18 feet.

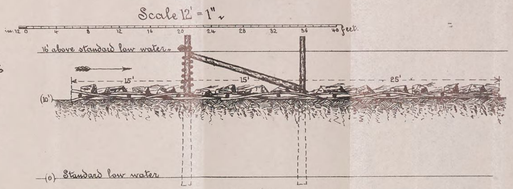


Fig. 6. Cross Section of Bundle in depths of from 3' to 6'.

Notes.

The bundles are built to the surface of the water unless the latter be lower than the plane 16' above standard low water, in which case they are built to the uniform height of 16' above standard low water. Their forms of construction vary somewhat with the depth of water at the 16' standard stage.

Figures 1, 2 and 5 show the normal type.

For depths of 15' or more, the distance between the rows of piles is about equal to the depth of water. For example, in a depth of 18', the distance between rows is 18' as shown in drawings. For depths less than 15', the distance is constant and is kept at 15', except next the shore. In the latter case and in other cases of sudden and brief shoaling no change is made in the distance generally employed in that particular bundle.

For depths of 3' to 6' only two rows of piles are used, as shown in Fig. 6.

For depths of 3' or less, only one row of piles is used.

For depths of 0, or over a dry bar, no piles are used, but the foundation mattress 55' wide is laid upon the bare surface and well ballasted with stone, except when the bar is already protected by a natural growth of willows.

For depths of over 16', or for less depths where the current is very swift, cross stringers are used to brace together the tops of the piles in the three rows as shown in Fig. 7.

The foundation mattress is 55' wide where there are two rows of piles or less. When there are three rows, the width of the mattress depends upon the distance between the rows; it extends 15' above the upstream row, and 25' below the downstream row, making its total width 76' in a depth of 18' as shown in drawings.

Wattling must be placed in horizontal layers. Depressions in the bottom are first filled, and then the wattling is carried up in horizontal courses extending from one end of the bundle to the other.

When a bundle crosses a depth of over 15' the wattling will not at first be carried to the tops of the piles. It will be placed to a height about 8' above standard low water, and then be left until the bundle shall be reinforced by deposits, after which it may be continued up to the full height.

The depth to which piles are driven should as a rule exceed the depth of water.

In most cases the bank near the shore end of a bundle should be protected for a distance of about 100' above and 100' below the axis of the bundle, the protection extending to the full height of the graded bank.

The construction of the bundle should begin at the shore end and progress continuously outward.

U.S. Engineer Office, St. Louis, Mo. March, 1885.

H Ext pt2 v2 49

Improvement of Mississippi River between Illinois and Ohio Rivers.

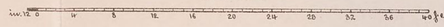
Major O. H. Ernst,
Corps of Engineers, U.S. Army.
Officer in Charge.

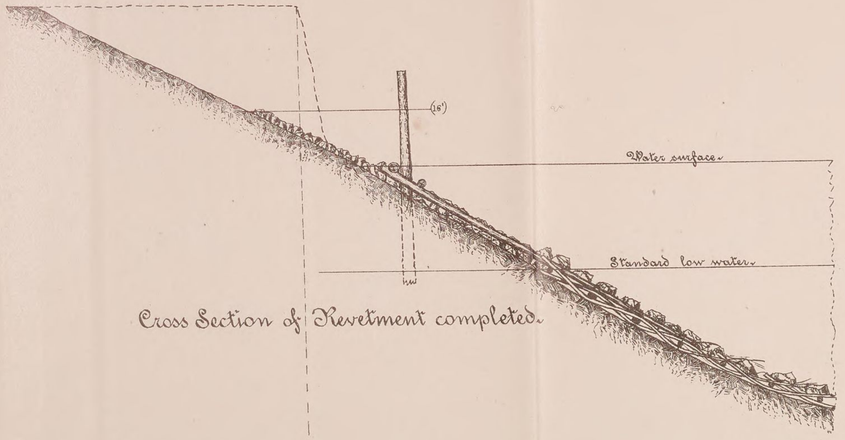
Bank Protection.

Below Missouri River.

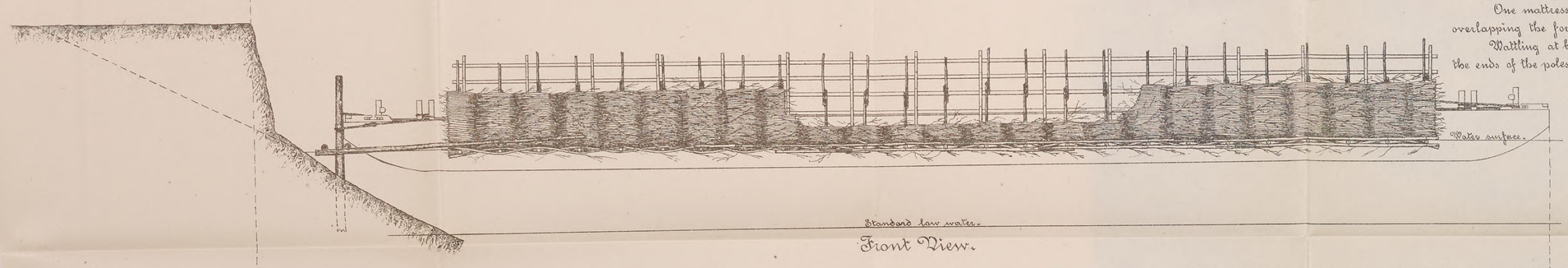
U. S. Engineer Office, St. Louis, Mo. March 1885.

Scale 12'=1".

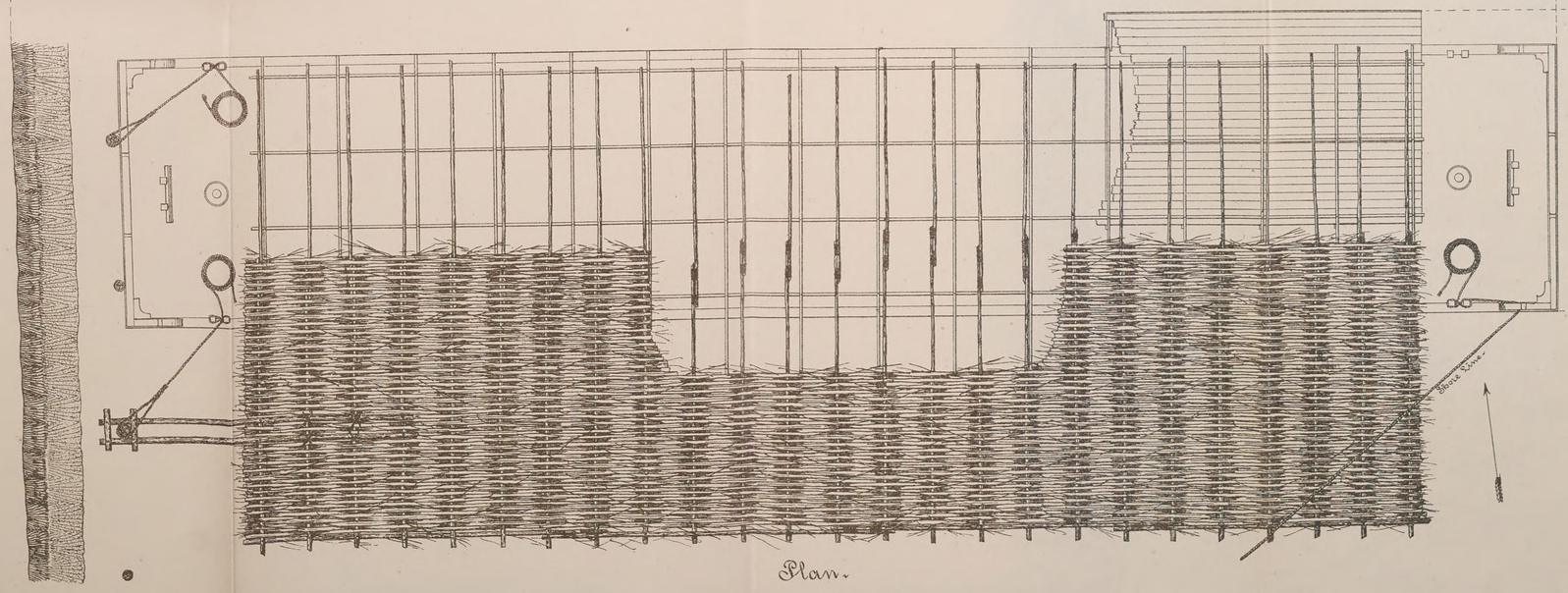




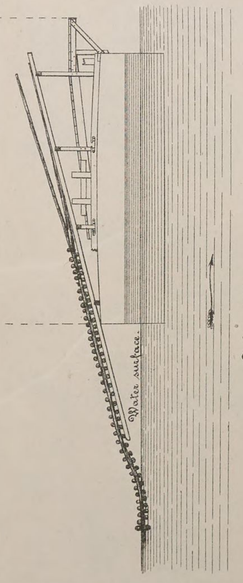
Cross Section of Revetment completed.



Front View.



Plan.



Side View.

Notes.

Mattress to be 120' wide, woven upon 25 continuous poles 5' apart. Poles to be securely spliced with wire tightened by rack-sticks, the ends of poles overlapping about 4', with three 6" spikes driven through the overlap.

In moderate depths and velocities, the mattress is launched and sunk progressively, and its length is unlimited. In great depths and velocities the length should not exceed 1000'.

Guide piles 15' apart to be driven upon a line distant 15' horizontally from standard low water mark. Standard low water is 4' above low water of 1863.

Shore edge of mattress after sinking should be about 15' outside of line of piles.

To hold it ready for this position poles acting both as spars and ties will extend from each guide pile and be secured to mattress. The upstream end of mattress during construction to be held above water surface by a raft or empty barge anchored at right angles to bank.

Stone sufficient to sink mattress and hold it securely in place to be scattered over it. In most cases, one cub. ft. of stone to 15 square feet of mattress is sufficient, at which rate a barge load of 300 cub. yds. of stone should sink 1000 linear feet of mattress.

Interval between inner edge of mattress and water surface to be covered with a liberal supply of stone – say 18" thick.

Bank above water surface to be graded to a slope of $\frac{1}{2}$ by hydraulic jet, or by natural action of the river; then to be covered to height of 16' above standard low water with a layer of stone 10" thick.

One mattress having been completed and sunk a new one will be begun overlapping the former by about 25'.

Matting at beginning of mattress to be secured by two stringers connecting the ends of the poles as a clamp.

H Ex1 pt2 v2 49 1

X 5.

PRELIMINARY EXAMINATION OF OSAGE RIVER, MISSOURI, FROM MOUTH TO LINN CREEK, WITH A VIEW TO MOVABLE LOCKS AND DAMS.

UNITED STATES ENGINEER OFFICE,
Saint Louis, Mo., August 22, 1884.

GENERAL: The river and harbor act of July 5, 1884, provides for the examination or survey of "Osage River, Missouri, from mouth to Linn Creek, with a view to movable locks and dams," upon the condition that after a preliminary examination it shall be deemed "worthy of improvement."

By your letter of July 31, 1884, I am directed to report as to whether, in my opinion, the stream is "worthy of improvement." From the wording of the law and from the fact that the Osage has already been the subject of some minor improvements, I understand the question now to be, is it worthy of improvement by movable dams? That is, is it worthy at this time of a radical and expensive improvement, which will cost several millions of dollars?

The Osage empties into the Missouri River at a point about 140 miles from its mouth. To improve the navigable capacity of the Osage beyond that of the Missouri would be almost, if not quite, useless. The navigable depth of the Missouri at low stage is about 3 feet. An improvement of the Missouri River has been projected, but the amount of time which must elapse before that improvement shall be completed is uncertain. It will probably be many years. But whether many or few it would seem proper to defer the inauguration of any scheme the usefulness of which is very largely dependent upon the safe navigation of the Missouri until such safety of navigation is an accomplished fact.

The distance from Linn Creek to the mouth of the Osage is about 107 miles. In this distance it passes through or touches five counties, Camden, Morgan, Miller, Cole, and Osage, the last two lying also on the Missouri River. Some portions of these counties will not be affected by the improvement of the Osage, but as it is difficult to say how much, the statistics of the entire counties will be used in determining the interests to be benefited. The total area of these counties is about 2,800 square miles. By the census of 1880 (see Compendium of the Tenth Census, pages 39, 40, 1553–1555, 788–792, and 738) their total population was 54,542; their total assessed valuation, real and personal, was $9,093,013; their total taxation, State, county, and town, was $175,222; and their total production of cereals, including wheat, corn, oats, rye, barley, and buckwheat, was about 5,000,000 bushels, the total production of the State of Missouri being about 247,000,000 bushels. The geology of these counties is known only in a vague way. They contain deposits of iron, lead, and coal, but the size of the deposits is unknown; those of iron are supposed to be large, and those of coal to be small. There are at present no extensive mining interests.

The total value of the commerce of the Osage River during the fiscal year ending June 30, 1882, was $950,778, of which $565,405 was floated in rafts (see Annual Report Chief of Engineers, 1882, page 1660), and for the year ending June 30, 1883, was $1,043,052, of which $215,790 was floated in rafts (see Annual Report Chief of Engineers, 1883, page 1295). Deducting the rafting interest, which would not be benefited, but which would rather be injured by a slackwater improvement, there remains a trade of $385,373 for 1882 and $827,262 for 1883. As near as can be computed from the data at hand the weight carried in 1882 was

9,416.5 tons, and in 1883, 21,967.5 tons. The average charge for freight in 1881 was $2 per ton, and in 1882 $4 per ton. Taking the higher rate the total freight charges would not exceed $38,000 in 1882 and $88,000 in 1883, or an average of $63,000 for each of the two years.

From these facts it appears that there are no interests at this time, either upon the Osage River itself or upon its banks, which will justify a heavy expenditure in the improvement of the river. There are undeveloped resources which such an improvement would aid to develop, but they are uncertain in amount. The most important results to be expected from a radical improvement cannot be attained until after the improvement of the Missouri River. I am accordingly of the opinion that the Osage River, from its mouth to Linn Creek, is not at this time worthy of improvement by movable dams.

Very respectfully, your obedient servant,

O. H. ERNST,
Major of Engineers.

Brig. Gen. JOHN NEWTON,
Chief of Engineers, U. S. A.

APPENDIX Y.

IMPROVEMENT OF YELLOWSTONE RIVER, MONTANA AND DAKOTA.

REPORT OF CAPTAIN JAMES B. QUINN, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1885.

UNITED STATES ENGINEER OFFICE,
Saint Paul, Minn., August 10, 1885.

GENERAL: I have the honor to inclose my annual report upon the improvement of the Yellowstone River in Montana and Dakota.

Very respectfully, your obedient servant,

JAMES B. QUINN,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

IMPROVEMENT OF YELLOWSTONE RIVER, MONTANA AND DAKOTA.

The funds available under the appropriation of July 5, 1884, permitted the continuation of the work of deepening the channel of the Yellowstone River below Glendive, Mont., by the method of confining the water of the river to a single channel by closing chutes and reducing width of channel at shoal places by the aid of brush dams, a method of improvement which has met with considerable success.

The work of improvement has reached a point 26 miles below Glendive, and, as far as observations have been practicable, appears to have withstood the effects of ice and other damaging influences remarkably well. A material increase in the depth of the water in the channel in the vicinity of the dams has already occurred, and the rectification of the channel has furthermore improved its navigability by causing a material reduction in the force of the current at hitherto difficult places.

The beneficial results so far attained appear to warrant the belief that the extension of the system will result in a measurably permanent improvement of the channel or a decidedly great amelioration of the difficulties which at present beset the navigation of this river.

During the last season's operations 2,504 running feet of dike was constructed, 45 feet of which was built in water having a depth of 13 feet and a very swift current. There were grave doubts as to whether this deep-water section of dam would be able to withstand the break-

ing-up of the ice in the spring; but it was found to have received very slight damage and to be capable of being easily repaired.

None of the other dams were found to be injured in the least.

Although the method of deepening the water in the channel by the means of dams and jetties has proved quite efficacious so far, the method is at best a slow one when employed alone. The possession of a good dredge would materially expedite matters, but the amounts hitherto appropriated for this work have not been sufficient to permit of its purchase.

A good dredge would cost $25,000, and a suitable tow-boat to be operated with it would cost, say, $10,000 more.

The running expenses of the dredge and tow-boat for one season would amount to $25,000, and for the construction of dams auxiliary to the dredging operations there would be required $10,000 more, making a total for the season's requirements of $70,000.

With such an equipment it is possible that the improvement of the river could be completed in three years at an annual outlay of $25,000 or, say, for the sum of $125,000 the improvement might be completed.

Although the condition of this river is much better than it was during the time when its commerce was so important, its commerce at present is insignificant, but there is a prospect that it will be shortly revived, as there is a scheme to ship up-Missouri River freights down this river to Buford, and thence up, instead of from Bismarck. The 100-miles haul from Glendive to Buford would be down-stream instead of 300 miles up-stream from Bismarck, as at present.

Money statement.

July 1, 1884, amount available		$856 22
Amount appropriated by act approved July 5, 1884		20,000 00
		20,856 22
July 1, 1885, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1884	$10,743 90	
July 1, 1885, outstanding liabilities	1,001 79	
		11,745 69
July 1, 1885, amount available		9,110 63
Amount (estimated) required for completion of existing project		125,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1887		100,000 00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

INDEX.

Subject.	Page.			
	Part I.		Part II.	Part III.
A.				
Absecom Inlet, N. J., examination of harbor at Atlantic City	127	862		
Agate and Burlington bays, Minn., examination and survey of	296			1954
Ahnapee Harbor, Wis., improvement of	303			1989
Alabama River, improvement of	203		1306	
Allegheny River, Pa., improvement of	283			1818
Alpena Harbor, Mich., improvement of	327			2129
Altamaha River, Ga., from Darien to its mouth, examination of	191		1234	
Altamaha River, Ga., improvement of	187		1218	
Alton, Ill., improvement of Mississippi River at	259		1656	
Amelia River, Fla., examination of	199		1284	
Amite River, La., improvement of	215		1391	
Anclote Harbor, Fla., examination of	199		1280	
Annapolis Harbor, Md., improvement of	134	886		
Ann, Cape, Mass., construction of harbor of refuge at Rockport	66	520		
Apalachicola Bay, Fla., improvement of	194		1258	
Apalachicola River, Fla., improvement of	198		1275	
Appomattox River, Va., improvement of	155		1029	
Aransas Pass and Bay, Tex., improvement of	229		1464	
Archer's Hope River, Va., improvement of	157		1034	
Arkansas River from Fort Gibson to Wichita, survey of	251		1611	
Arkansas River at Fort Smith, Ark., improvement of	245		1563	
Arkansas River from Little Rock to its mouth, survey of	251		1601	
Arkansas River at Pine Bluff, improvement of	245		1564	
Arkansas River, improvement of, between Fort Smith Ark., and Wichita	245		1561	
Arkansas River, operations of snag-boats on	244		1558	
Armor plates and turrets, &c., information in relation thereto	421			
Ashland Harbor, Wis., in Ashland Bay, Lake Superior, examination and survey of	307			2010
Ashley River, S. C., improvement of	180		1188	
Ashtabula Harbor, Ohio, improvement of	342			2240
Atchafalaya River, La, above Berwick Bay, examination and survey of	226		1432	
Atlantic City Harbor, N. J., at Absecon Inlet, examination of	127	862		
Au Sable Harbor, Mich., improvement of	327			2130
B.				
Back Bay, at Handsboro', Miss., examination of	214		1373	
Baldwin River, N. Y., at Baldwin Station, to connect with Long Beach, examination of	114	789		
Baltimore, defenses of	28			
Baltimore Harbor, improvement of entrance to	137		917	
Bangor Harbor, Me., improvement of	55	464		
Barren River, Ky., report on condition of	292			1904

Subject.	Page. Part I.	Part II.	Part III.
Battalion of Engineers	52 427		
Bay of Superior, Wis., improvement of	294		1944
Bayou Bartholomew, Ark., examination of, from present head of navigation to Lincoln County line	244	1548	
Bayou Bartholomew, La. and Ark., improvement of	235	1501	
Bayou Black, La., improvement of	219	1400	
Bayou Bœuf, La., improvement of	235	1502	
Bayou Courtableau, La., improvement of	220	1403	
Bayou D'Arbonne, La., improvement of	236	1505	
Bayou La Fourche, La., improvement of	221	1408	
Bayou Macon, La., improvement of	236	1504	
Bayou Pierre, Miss., examination of	226	1439	
Bayou Pierre, La., survey of	232	1487	
Bayou Plaquemine, La., examination of	225	1431	
Bayou Teche, La., connecting with Grand Lake	218	1399	
Bayou Teche, La., improvement of	217	1397	
Bayou Teche, La., removal of wrecks from	225	1428	
Bayou Terrebonne, La., improvement of	221	1407	
Beattyville, Ky., report on lock and dam in Kentucky River, at	288		1872
Beaufort, N. C., to New Berne, inland navigation between, improvement of	167	1070	
Beaufort, N. C., defenses of	33		
Beaufort Harbor, N. C., improvement of	168	1076	
Beaufort and New River, N. C., examination and survey of sound between	177	1133	
Belfast Harbor, Me., improvement of	57 467		
Belle River, Mich., ice harbor at	329		2157
Benton Harbor, Saint Joseph's River, Mich., improvement of	321		2086
Big Black River, Miss., improvement of	241	1524	
Big Hatchie River, Tenn., improvement of	242	1527	
Big Sandy River, West Va. and Ky., improvement of	290		1884
Big Stone Lake, examination with view to connecting Lake Traverse with	296		1951
Big Sunflower River, Miss., improvement of	238	1511	
Biloxi, Miss., improvement of harbor at	212	1360	
Bisteneau Lake, La., improvement of	233	1496	
Black Bayou, La., improvement of	219	1400	
Black Lake Harbor, Mich., improvement of	320		2083
Black River, Ark. and La., improvement of	234	1497	
Black River, Ark. and Mo., improvement of	247	1583	
Black River, N. C., examination and survey of	177	1145	
Black River Harbor, Ohio, improvement of	339		2223
Black Rock Harbor, Conn., improvement of	86 653		
Black Warrior River, Ala., improvement of	210	1354	
Blackwater River, Va., improvement of	157	1033	
Block Island, R. I., construction of harbor of refuge at	76 606		
Blue Buck Bar, Tex., improvement of	223	1415	
Board of Engineers for Fortifications and for River and Harbor Improvements	48		
Board of Engineers for the Pacific Coast	52		
Bœuf River, La., examination with view to closing outlets of	244	1545	
Bœuf River, La., improvement of	235	1502	
Bogue Sound, N. C., between New River and Beaufort, examination and survey of	177	1133	
Boston, Mass., defenses of	11		
Boston Harbor, Mass., examination and survey of Fort Point Channel	67 543		
Boston Harbor, Mass., improvement of	63 502		
Brazos River, Tex., improvement of mouth of	228	1460	
Brazos Santiago, Tex., improvement of harbor at	229	1468	
Breton Bay, Md., improvement of	145	964	

Subject.	Page.				
	Part I.		Part II.	Part III.	
Bridge across Detroit River between Belle Isle and the American shore	292			1917	
Bridge across Monongahela River near Fairmont, W. Va	293			1919	
Bridge across Saint Louis River, Minn. and Wis., for the Northern Pacific Railroad Company	293			1925	
Bridge across Willamette River at Portland, Oreg	292			1917	
Bridging navigable waters of the United States	292			1917	
Bridgeport Harbor, Conn., improvement of	85	651			
Broad Creek, Del., improvement of	130	880			
Broadkiln River, Del., improvement of	130	879			
Brown, Fort, Tex., protection of river bank at	230		1470		
Brunswick Harbor, Ga., improvement of	188		1224		
Buckhannon River, W. Va., improvement of	291			1892	
Buffalo Bayou, Tex., improvement of	227		1457		
Buffalo Harbor, N. Y., improvement of	345			2255	
Buffalo River, Miss., examination of	225		1430		
Burlington Bay, Minn., examination and survey of Agate and	296			1954	
Burlington Harbor, Vt., improvement of	355			2307	
Buttermilk Channel, New York Harbor, improvement of	92	670			
C.					
Cahaba River, Ala., improvement of	204		1308		
Calcasieu Pass, La , improvement of	222		1414		
Calcasieu River, La., improvement of	221		1409		
Caloosahatchee River, Fla., improvement of	197		1273		
Calumet Harbor, Ill., improvement of	313			2015	
Calumet River, improvement of	314			2055	
Calumet River, examination and survey of, from a point half a mile east of Hammond to forks of the river	315			2059	
Calumet River, examination for proposed ship-canal from, to Lake Calumet	315			2057	
Cambridge Harbor, Md., improvement of	135	888			
Canal at the Cascades, Columbia River, Oreg., construction of	370			2426	
Canal at Des Moines Rapids, Mississippi River	264			1700	
Canal, Hennepin, surveys for	314			2056	
Canal, Louisville and Portland, operating and maintaining	281			1803	
Canal, Muscle Shoals, Tennessee River, construction of	274			1753	
Canal, Saint Clair Flats, Mich	329			2160	
Canal, Saint Mary's Falls, Mich	325	332		2104, 2186	
Canal and inland communication from the Saint John's River, through Mosquito Lagoon and Indian River, to Jupiter Inlet and Lake Worth, Fla., examination for	199		1291		
Canal from Calumet River to Calumet Lake, examination for proposed	315			2057	
Canarsie Bay, N. Y., improvement of	99	739			
Cane River, La., examination of	233		1495		
Caney Fork River to Franks Ferry, extension of the survey of	279			1774	
Caney Fork River, Tenn., improvement of	278			1768	
Cape Ann, Mass., construction of harbor of refuge at Rockport	66	520			
Cape Fear River, N. C., examination of northeast branch of	177		1128		
Cape Fear River, N. C., improvement of, below Wilmington	171		1087		

Subject.	Page. Part I.		Part II.	Part III.
Cape Fear River, N. C., improvement of, from Wilmington to Fayetteville	170		1083	
Cape Girardeau, improvement of Mississippi River at	259		1656	
Cashie River, N. C., examination and survey of, from its mouth to the town of Windsor	164		1053	
Cassidy's Bayou, Miss., examination of	243		1534	
Cedar Keys Harbor, Fla., improvement of	196		1270	
Cedar River, Mich., improvement at mouth of	299			1976
Channel between Staten Island and New Jersey, improvement of	104	749		
Charenton Canal, Saint Mary's Parish, La., improvement of	218		1399	
Charleston, S. C., defenses of	34			
Charleston Harbor, S. C., improvement of	177		1172	
Charlevoix Harbor, Mich., improvement of	315			2065
Charlotte Harbor, Fla., examination of	199		1286	
Charlotte Harbor, N. Y., improvement of	348			2271
Chattahoochee River, Ala. and Ga., improvement of	202		1303	
Cheboygan Harbor. Mich., improvement of	326			2128
Cheesequakes Creek, N. J., improvement of	101	743		
Chehalis River, Wash., improvement of	367			2405
Chesapeake Bay, removal of wrecks in	137	890		
Chester River, Md., at Kent Island Narrows, improvement of	133	884		
Chester River, Md., from Spry's Landing to Crumpton, improvement of	133	884		
Chicago Harbor, Ill., improvement of	312			2047
Chickahominy River, Va., improvement of	150		987	
Chincoteague Bay, Va., to Delaware Bay, at or near Lewes, Del., examination and survey with a view to form continuous inland navigation from	137	891		
Chippewa River, Wis., improvement of	268			1734
Chippewa River at Yellow Banks, Wis., improvement of	269			1737
Choctawhatchee River, Fla. and Ala., improvement of	205		1311	
Choptank River, Md., improvement of	134	886		
Cincinnati, Ohio, construction of ice-harbor near	284			1825
Clearwater Harbor, Fla, examination and survey of	267		1323	
Clearwater River, Idaho, improvement of Lower	371			2439
Cleveland, Ohio, examination on opening and improving the channel known as Old River Bed of the Cuyahoga River	344			2249
Cleveland Harbor, Ohio, improvement of	340			2227
Cleveland Harbor, Ohio, breakwater at	340			2229
Clinch River, Tenn., improvement of	277			1766
Clinton Harbor, Conn., improvement of	83	643		
Clinton River, Mich., examination and survey of mouth of	332			2190
Clinton River, Mich., improvement of entrance to	330			2165
Clubfoot River, N. C., improvement of	167		1070	
Coanjok Bay, N. C., improvement of	159		1039	
Cocheco River, N. H., improvement of	59	474		
Cockpit Point, Va., examination for ice-harbor	153		999	
Cœur d'Alene Lake and River, Idaho, examination of	372			2442
Cohansey Creek, N. J., improvement of	125	853		
Colonial Beach, formerly White Point, Westmoreland County, Va., examination and survey of	153		1001	
Coldwater River, Miss., improvement of	240		1518	
Colorado River, Cal., Nev., and Ariz., improvement of	363			2365
Columbia River, Oreg., construction of canal at the Cascades	370			2426
Columbia River, Oreg., defenses of	48			
Columbia River, Lower, Oreg., improvement of	364			2376
Columbia River, Oreg., improvement of mouth of	364			2382
Columbia River, Upper, and Snake River, Oreg., improvement of	370			2437

Subject.	Page. Part I.		Part II.	Part III.
Columbia River, above mouth of Snake River, examination of	372			2445
Columbia River, Oreg., water-gauges on Lower	368			2408
Conecuh River, Ala., improvement of	205		1309	
Congaree River, S. C., examination and survey of	177		1140	
Conneaut Harbor, Ohio, improvement of	343			2245
Connecticut River above Hartford, Conn., improvement of	80	632		
Connecticut River below Hartford, Conn., improvement of	80	633		
Contentnia Creek, N. C., improvement of	164		1060	
Corsons Sound, N. J., examination of	126	858		
Coosa River, Ala. and Ga., improvement of	201		1301	
Coosawattee River, Ga., improvement of	201		1300	
Coos Bay, Oreg., improvement of entrance to	365			2388
Coquille River, Oreg., improvement of mouth of	366			2398
Corsica Creek, Md., improvement of	133	884		
Courtableau Bayou, La., improvement of	220		1403	
Cowlitz River, Wash., &c., improvement of	371			2439
Cross Village, Mich., examination with view to making a harbor of refuge at	332			2185
Cumberland River above the mouth of the Jellico, Ky., examination of condition of	279			1772
Cumberland River above the mouth of the Jellico, Ky., improvement of	276			1764
Cumberland River, Ky., South Fork of, improvement of	279			1770
Cumberland River, Tenn. and Ky., improvement of	274			1760
Cumberland Sound, Fla. and Ga., defenses of	37			
Cumberland Sound, Fla. and Ga., improvement of entrance to	189		1229	
Currituck Sound, improvement of	159		1039	
Cuyahoga River, Ohio, at Cleveland, examination on the opening and improving of the channel known as the Old River Bed	344			2249
Cypress Bayou, Tex. and La., improvement of	232		1493	
Cypress Bayou, Tex., and lakes between Jefferson, Tex., and Shreveport, La., resurvey of	244		1552	
D.				
Dan River, Va. and N. C., improvement of	151		993	
D'Arbonne Bayou, La., improvement of	236		1505	
Darien Harbor, Ga., examination and survey of	191		1237	
Davis Island, lock and dam, Ohio River, construction of	280			1784
Davis Island, lock and dam, Ohio River, operating and care of	281			1802
Deer Creek, Miss., examination of	244		1538	
Defenses of the northern frontier	5			
Defenses, sea-coast and lake frontier, general remarks on and estimates for	4			
Defenses, torpedo	50			
Delaware Breakwater Harbor, improvement of	122	846		
Delaware Bay, construction of ice harbor at head of	121	840		
Delaware Bay and River, removal of wrecks from	126	855		
Delaware Bay, examinations and surveys with a view to form continuous inland navigation from Chincoteague Bay, Va., to, at, or near Lewes, Del	137	891		
Delaware River:				
at Schooner Ledge, improvement of	118	835		
below Bridesburg, Pa., improvement of	117 834	804		
between Trenton and Bridesburg, Pa., improvement of	116 833	802		

Subject.	Page. Part I.		Part II.	Part III.
Delaware River—Continued.				
between Trenton and its mouth, improvement of..	115	798		
near Cherry Island Flats, improvement of	119	836		
Des Moines Rapids Canal, Mississippi River, operating and care of	264			1700
Des Moines Rapids Canal, Mississippi River, dry dock at	265			1707
Des Moines Rapids, Mississippi River, improvement at.	263			1697
Detroit River, Mich., improvement of	331			2165
Detroit River, Mich., bridge across, between Belle Isle and the American shore	292			1917
Dorcheat Bayou, La., improvement of	233		1496	
Dry Tortugas Harbor, Fla., defenses of	39			
Dubuque, Iowa, improvement of harbor at	262			1691
Duck Creek, Del., improvement of.....	129	876		
Duck River, Tenn., improvement of	277			1768
Duluth Harbor, Minn., improvement of.....	294			1937
Dunkirk Harbor, N. Y., improvement of	343			2246
Duties and rank of officers of the Corps of Engineers .	379			
E				
Eagle Harbor, Mich., improvement of	297			1970
East Chester Creek, N. Y., improvement of	98	738		
Easton Point, Md., examination of harbor at.....	137	890		
East River, N. Y., removal of obstructions from.....	96	715		
East River, N. Y., removal of Pilgrim Rock from	97	733		
Echo Harbor, New Rochelle, N. Y., improvement of ..	89	661		
Edenton Bay, N. C., improvement of	159		1038	
Edisto River, S. C., improvement of	181		1190	
Edisto River, S. C., North Fork of the, in the counties of Orangeburg and Lexington, examination and survey of	191			
Elizabeth River, N. J., improvement of	106	754		
Elk River, Md., improvement of.....	132	883		
Elk River, W. Va., improvement of.....	286			1857
Elk River, Tenn. and Ala., examination of.....	279			1771
Engineer depot and post at Willets Point	53	457		
Engineers, battalion of.....	52	427		
Engineers, Board of, for Fortifications and for River and Harbor Improvements	48			
Engineers, Board of, for the Pacific Coast.....	52			
Engineers, school of application at Willets Point, N. Y .	52	427		
Erie Harbor, Pa., improvement of	344			2253
Escambia River, Ala. and Fla., improvement of	205		1309	
Estimates for surveys and examinations, and contingencies of rivers and harbors.....	372			
Explorations and reconnaissances in military divisions and departments	376			
Explorations and reconnaissances, estimates for, in military divisions and departments	378			
Explorations and surveys in Department of Arizona...	378			2531
Explorations and surveys in Department of California.	377			2529
Explorations and surveys in Department of Dakota...	377			2527
Explorations and surveys in Department of the Platte.	377			2525
Explorations and surveys in Department of Texas	377			2521
Explorations and surveys in Division of the Pacific....	377			2529
Explorations, geographical, &c., west of one hundredth meridian	376			
F.				
Fairport Harbor (Grand River), Ohio, improvement of.	341			2235
Falkner's Island, Conn., examination for breakwater at.	96	707		

Subject.	Page.			
	Part I.		Part II.	Part III.
Falls of Saint Anthony, Minn., preservation of	266			1721
Falls of the Ohio River, improvement of navigation at	282			1811
Feather River, Cal., improvement of	362			2360
Fernandina and Saint John's River, Fla., deepening the inside passage between	191		1234	
Fishways at Great Falls of Potomac River	374			2499
Flint River, Ga., improvement of	201		1298	
Flushing Bay, N. Y., improvement of	90	666		
Fort Brown, Tex., protection of river bank at	230		1470	
Fort Greene, Newport, R. I., transfer of, for public park	15	423		
Fort Point Channel, Boston Harbor, Mass., examination and survey of	67	543		
Fox and Wisconsin rivers, improvement of	310			2025
Frankford Creek, Pa., improvement of	119	836		
Frankfort Harbor, Mich., improvement of	315			2068
French Broad River. N. C., improvement of	152		997	
French Broad River, Tenn., improvement of	276			1765
G.				
Galveston, Tex., defenses of	45			
Galveston Bay, ship channel in, improvement of	226		1454	
Galveston Harbor, Tex., improvement of entrance to	226		1449	
Gasconade River, Mo., improvement of	254		1637, 1654	
Gedney's Channel, New York harbor, N. Y	113	766		
Geographical explorations and surveys west of the one hundredth meridian	376			
Georgetown and Washington harbors, D. C., improvement of	139		923	
Georgetown Harbor, S. C., improvement of	174		1114	
Gloucester Harbor, Mass., examination and survey with a view to removal of rock obstructions	67	540		
Goose Rapids, Red River of the North, Minn. and Dak.	271			1745
Gowanus Bay, N. Y., improvement of	93	672		
Grand Haven Harbor, Mich., improvement of	319			2079
Grand Marais, Mich., harbor of refuge at	298			1973
Grand Marais, Minn., improvement of harbor at	295			1949
Grand River, Mich., improvement of	320			2081
Grass River, N. Y., improvement of, at Massena	353			2296
Great Kanawha River, W. Va., improvement of	285			1845
Great Kanawha River, W. Va., construction of harbor of refuge at mouth of	284			1826
Great Pee Dee River, S. C., improvement of	172		1100	
Great Sodus Harbor, N. Y., improvement of	349			2274
Green Bay, Wis., improvement of harbor at	302			1987
Greenbrier River, W. Va., examination of	288			1866
Greenport Harbor, N. Y., improvement of	89	664		
Green River, Ky., report on condition of	292			1904
Green River, N. C., examination of	164		1046	
Guttenberg, Iowa, examination and survey of Mississippi River in the vicinity of	266			1718
Guyandotte River, W. Va., improvement of	290			1889
H.				
Hampton Roads, Va., defenses of	31			
Handsboro', Miss., examination of Back Bay at	214		1373	
Harbor of refuge, Block Island, R. I., construction of	76	606		
Harbor of refuge, Belle River, Mich., construction of	329			2157
Harbor of refuge, near Cincinnati, Ohio, construction of	284			1825
Harbor of refuge, Cross Village, Mich., examination for	332			2185
Harbor of refuge, Grand Marais, Mich	298			1973

Subject.	Page.			
	Part I.		Part II.	Part III.
Harbor of refuge, Great Kanawha River, W. Va., construction of	284			1826
Harbor of refuge, Lake Huron, construction of	328			2151
Harbor of refuge, Lake Pepin, Mississippi River, construction of	262		1657	
Harbor of refuge, Milwaukee Bay, construction of	307			2015
Harbor of refuge, Portage Lake, Lake Michigan, construction of	316			2069
Harbor of refuge, mouth of Salmon River and the inner natural harbor thereat, on Lake Ontario, examination and survey for	352			2291
Harbor of refuge, Sand Beach, Lake Huron	328			2151
Harbor of refuge, Sandy Bay, Cape Ann, Mass., construction of	66	520		
Harbor of refuge, Stonington, Conn., construction of	78	616		
Harbor of refuge, Sturgeon Bay Canal, Wis., construction of	302			1988
Harbor of refuge, Wood's Holl, Mass., construction of	69	580		
Harlem River, N. Y., improvement of	93	674		
Harlow River, N. C., improvement of	167		1070	
Hay Lake Channel, Saint Mary's River, Mich., improvement of	324			2098
Hell Gate, N. Y., improvement of navigation at	96	715		
Hennepin Canal, surveys for	314			2056
Hingham, Mass., examination and survey of harbor at	67	553		
Hiwassee River, Tenn., improvement of	276			1764
Holston River, Tenn., examination of	279			1773
Homochitto River, Miss., examination of	225		1429	
Homosassa Bay, Fla., examination of	214		1373	
Horn Island Pass, Miss., improvement of	212		1361	
Horton's Point, near Dutch Pond Point, N. Y., examination for a breakwater at	95	701		
Housatonic River, Conn., improvement of	85	649		
Hudson River, N. Y., examination and survey of, from Troy to mouth of canal	96	711		
Hudson River, on the New Jersey side, from Weehawken to Bergen Point, N. J., examination and survey with view to deepening the water on that side	115	790		
Hudson River, N. Y., improvement of	94	677		
Humboldt Bay and Harbor, Cal., improvement of	361			2351
Huntington Harbor, N. Y., examination and survey of	96	703		
Huron Harbor, Ohio, improvement of	337			2219
Hyannis, Mass., examination and survey with view to deepening the harbor	80	619		
Hyannis Harbor, Mass., improvement of	68	560		
I.				
Ice-harbor at Belle River, Mich., construction of	329			2157
Ice-harbor near Cincinnati, Ohio, construction of	284			1825
Ice-harbor at Cockpit, Va., examination and survey for	153		999	
Ice-harbor at head of Delaware Bay	121	840		
Ice-harbor at Dubuque, Iowa	262			1691
Ice-harbor at Marcus Hook, Pa., construction of	120	839		
Ice-harbor at mouth of Muskingum River	283			1821
Ice-harbor at New Castle, Del	128	872		
Illinois and Michigan Canal, surveys for enlargement of	314			2056
Illinois River, improvement of	313			2052
Indian River, Del., improvement of	131	881		
Inland communication from the Saint John's River, through Mosquito Lagoon and Indian River, to Jupiter Inlet and Lake Worth, Fla., examination for	199		1291	

Subject.	Page. Part I.	Part II.	Part III.
Inland navigation from Chincoteague Bay, Va., to Delaware Bay at or near Lewes, Del., examinations and surveys with view to forming continuous	137 891		
Inland navigation from New Berne to Beaufort, N. C., improvement of	167	1070	
Inside passage between Fernandina and Saint John's River, Fla., improvement of	191	1234	
Islias Creek, San Francisco Bay, Cal., examination of	360		2340
J.			
James River, Va., improvement of	142	944	
Jeffersonville, Ind., construction of a levee at	281		1796
Jetties at South Pass of the Mississippi River, inspection of	214	1377	
Jonesport, Me., improvement of Moose-a-bec Bar at	56 465		
Jupiter Inlet and Lake Worth, Fla., examination for inland communication from the Saint John's River through the Mosquito Lagoon and Indian River to	199	1291	
K.			
Kanawha River, Great, improvement of	285		1845
Kanawha River, Great, construction of harbor of refuge at mouth of	284		1826
Kanawha River, Little, improvement of	291		1890
Kankakee River, Ind., examination of	257	1645	
Kennebec River, Me., defenses of	7		
Kennebunk River, Me., improvement of	58 470		
Kenosha Harbor, Wis., improvement of	309		2021
Kent Island Narrows, Md., improvement of	133 884		
Kentucky River, Ky., improvement of	288		1869
Kentucky River, Ky., operating and keeping in repair locks and dams on	289		1878
Kentucky River, Ky., lock and dam at Beattyville, report on	288		1872
Kewaunee Harbor, Mich., improvement of	303		1993
Keyport Harbor, N. J., improvement of	111 763		
Key West, Fla., defenses of	38		
Key West, Fla., improvement of harbor at	195	1267	
L.			
Lac la Belle Harbor, Mich., examination and survey of	307		2005
La Fourche Bayou, La., improvement of	221	1408	
La Grange Bayou, Fla., improvement of	206	1312	
Lake Bisteneau, La., examination of	233	1496	
Lake Champlain, examination and survey at Four Channels, N. Y	357		2314
Lake City, Minn., construction of harbor of refuge at	262		1687
Lake Huron, harbor of refuge on, at Sand Beach, Mich.	328		2151
Lakes, northern and northwestern, issue of charts of	375		2519
Lake Traverse and Big Stone Lake, Minn., examination with view to connecting	296		1951
Lake Worth and Jupiter Inlet, Fla., examination for inland navigation from the Saint John's River through Mosquito Lagoon and Indian River to	199	1291	
L'Anguille River, Ark., improvement of	251	1600	
Lawrenceburg Harbor, Ind., examination and survey of	285		1839
Laws of Forty-eighth Congress, second session, affecting Corps of Engineers	401		
Leonardtown Harbor, Md., improvement of	145	964	
Lewes, Del., construction of piers at	121 845		
Lewis River, Wash., examination of	372		2444

Subject.	Page. Part I.		Part II.	Part III.
Licking River, Ky., examination and survey of bar opposite mouth of	285			1843
Little Egg Harbor, N. J., removal of wreck off	126	856		
Little Harbor at Portsmouth, N. H., examination of	60	480		
Little Kanawha River, W. Va., improvement of	291			1890
Little Narragansett Bay, R. I. and Conn., improvement of	78	615		
Little Red River, Ark., examination and survey of	252		1612	
Little River, Ky., examination of	279			1772
Little Sodus Harbor, N. Y., improvement of	350			2276
Little Tennessee River, improvement of	278			1769
Little Traverse Bay, Mich., examination for harbor of refuge near Petoskey	324			2095
Loggy Bayou, La., improvement of	233		1496	
Long Beach, N. Y., examination and survey of Baldwin River at Baldwin Station to connect with	114	789		
Louisville and Portland Canal, operating and maintaining	281			1803
Lower Clearwater River, Idaho, improvement of	371			2439
Lower Wiliamette and Columbia rivers, Oreg., improvement of	364			2376
Lubec Channel, Me., improvement of	55	462		
Ludington Harbor, Mich., plan and estimate for harbor of refuge at	324			2090
Ludington Harbor, Mich., improvement of	317			2072
Lynn Harbor, Mass., improvement of	65	516		
M.				
Mackinac Harbor, Mich., examination of	332			2180
Malden River, Mass., improvement of	66	519		
Mamaroneck Harbor, N. Y., improvement of	89	662		
Manasquan River, N. J., improvement of	107	756		
Manatee River, Fla., improvement of	197		1272	
Manistee Harbor, Mich., improvement of	316			2071
Manistique Harbor, Mich., improvement of	299			1974
Manitowoc Harbor, Wis., improvement of	305			1998
Mantua Creek, N. J., improvement of	123	850		
Maps, military and geographical, preparation of	375			
Maquam Bay, Swanton, Vt., examination and survey of	357			2321
Marblehead Harbor, Mass., examination for repair of sea-wall	67	537		
Marcus Hook, Pa., improvement of ice-harbor at	120	839		
Marquette Harbor, Mich., improvement of	297			1971
Massena, N. Y., improvement of Grass River, at	353			2296
Matagorda Bay, Tex., improvement of entrance to	228		1462	
Mattaponi River, Va., improvement of	148		979	
Mattawan Creek, N. J., improvement of	111	763		
Maurice River, N. J. improvement of	127	868		
Meeker's Island, Minn., lock and dam at	268			1733
Meherrin River, N. C., improvement of	160		1041	
Menomonee Harbor, Mich. and Wis., improvement of	299			1978
Merrimac River, Mass., improvement of	61	499		
Michigan City Harbor, Ind., improvement of	322			2088
Milford Harbor, Conn., improvement of	84	648		
Milwaukee Bay, construction of harbor of refuge at	307			2015
Milwaukee Harbor, Wis., improvement of	308			2018
Minnesota River, Minn., improvement of	270			1741
Mispillion Creek, Del., improvement of	130	878		
Mississippi (Lower) and Missouri rivers, operations of snag-boats on	252	253	1633, 1652 1634, 1653	
Mississippi River:				
above Falls of Saint Anthony, improvement of	267			1731
at Alton, Ill., improvement of	259		1656	

Subject.	Page. Part I.	Part II.	Part III.
Mississippi River—Continued.			
at Cape Girardeau, improvement of	259	1656	
at Des Moines Rapids, improvement of	263		1697
at Dubuque, Iowa, improvement of	262		1691
at Falls of Saint Anthony, improvement of	266		1721
at Lake Pepin, construction of harbor of refuge	262		1687
at Meeker's Island, Minn., construction of lock and dam	268		1733
at Quincy Bay, Ill., improvement of	265		1709
at Rock Island Harbor, improvement of	263		1695
at Rock Island Rapids, improvement of	263		1694
examination and survey for removal of the bar and obstructions at and near the mouth of Whipple Creek, in Quincy Bay	266		1717
opposite Saint Louis, Mo., improvement of	259	1656	
Sny Island Levee, examination of	266		1710
between the mouths of the Illinois and Ohio rivers, improvement of	259	1655	
in the vicinity of Guttenberg, Iowa, examination and survey of	266		1718
from Des Moines Rapids to mouth of Illinois River, improvement of	261		1685
from Saint Paul to Des Moines Rapids, improvement of	261		1667
improvement of South Pass, inspection of	214	1377	
reservoirs at sources of	272 273		1747, 1750
snag-boats on, operations of	252	1633, 1652	
Upper, operations of snag-boats on	260 265		1662, 1710
water gauges on	243	1532	
Mississippi River Commission, report of	258	Part IV	p. 2535
Mississippi Sound, defense of	41		
Missouri River:			
between Sioux City and its mouth, improvement of		1654	
snag-boats on, operations of	253	1634, 1653	
from its mouth to Fort Benton, Mont., survey of		1654	
examination and survey of Nish-na-botna River, Mo., with a view to increasing depth of channel in the	257	1643	
Missouri River Commission, report of	258	Part IV	p. 2989
Mobile, Ala., defenses of	41		
Mobile Harbor, Ala., improvement of	207	1336	
Mobile River and Harbor, Ala., from lower anchorage up to northern limits of city of Mobile, with view to securing 23 feet depth of water, examination and survey of	214	1374	
Mokelumne River, Cal , improvement of	362		2358
Monongahela River, improvement of	282		1813
Monongahela River, operating and care of lock and dam No. 9	282		1817
Monongahela River, bridge across, near Fairmont, W. Va	293		1919
Monroe Harbor, Mich., improvement of	332		2209
Moose-a-bec Bar, Jonesport, Me., improvement of	56 465		
Mosquito Inlet, Fla., examination and survey of	199	1287	
Mosquito Lagoon and Indian River, Fla., examination for inland communication from the Saint John's River through to Jupiter Inlet and Lake Worth, Fla	199	1291	
Mount Vernon, Va., improvement of channel at	144	962	
Movable dam at Davis Island, Ohio River	280 281		1784, 1802
Movable dams, examination of models and plans for	288		1859
Muscle Shoals Canal, Tennessee River, construction of	274		1753
Muskegon Harbor, Mich., improvement of	319		2077
Muskingum River, construction of ice-harbor at	283		1821
Muskingum River, Ohio, examination and survey of	285		

Subject.	Page. Part I.		Part II.	Part III.
N.				
Nantucket Harbor, Mass., improvement of	68	561		
Napa River, Cal., from mouth to Napa City, examination and survey of	360			2343
Narragansett Bay, defenses of	13			
Narragansett Bay, R. I., improvement of	73	596		
Natalbany River, La., examination of	226		1446	
Neabsco Creek, Va., improvement of	144		962	
Neches River, Tex., improvement of	225		1426	
Nehalim Bay and River, Oreg., examination of bar at the mouth of the entrance to	368			2409
Neuse River, N. C., improvement of	166		1065	
New Albany Harbor, and the river and shores adjacent thereto, examination of	284			1829
New Bedford, Mass., defenses of	12			
New Berne and Beaufort, N. C., inland navigation between, improvement of	167		1070	
New Buffalo Harbor, Mich., improvement of	322			2087
Newburyport Harbor, Mass., improvement of	60	494		
New Castle, Del., ice-harbor at	128	872		
New Haven Harbor, Conn., construction of breakwater at	84	646		
New Haven Harbor, Conn., defenses of	16			
New Haven Harbor, Conn., improvement of	83	644		
New Haven Harbor, Conn., removal of wreck from	95	700		
New London Harbor, Conn., defenses of	15			
New London Harbor, Conn., improvement of	82	641		
New Orleans, La., defenses of	42			
New Orleans Harbor, La., removal of wrecks from	225		1427	
Newport Harbor, R. I., improvement of	75	603		
Newport River, N. C., improvement of	167		1070	
New River, N. C., improvement of	169		1082	
New River and Beaufort, N. C., examination and survey of sound between	177		1133	
New River, Va. and W. Va., improvement of	287			1859
New Rochelle Harbor, N. Y., improvement at	88	660		
Newtown Creek, N. Y., improvement of	91	668		
New York Harbor, defenses of	16			
New York Harbor, removal of wrecks in	114	787		
New York Harbor, Gedney's channel in, improvement of	113	766		
Niagara River, N. Y., from Youngstown to Lake Ontario, examination of	352			2283
Niagara River, N. Y., improvement of	346			2268
Niantic River and Harbor, Conn., examination of	96	710		
Nish-na-botana River, Mo., examination with view to increasing depth of channel in Missouri River	257		1643	
Nomini Creek, Va., improvement of	145		966	
Nootsack River, Wash., improvement of	367			2403
Norfolk Harbor, Va., and its approaches, improvement of	153	154	1008, 1017	
Northern and Northwestern Lakes, issue of charts of	375			2519
North Landing River, Va. and N. C., improvement of	158		1035	
North River Bar, Currituck Sound, N. C., improvement of	159		1039	
Norwalk Harbor, Conn., improvement of	87	656		
Nottoway River, Va., improvement of	156		1033	
Noxubee River, Miss., improvement of	211		1356	
O.				
Oakland Harbor, Cal., improvement of	357			2327
Oak Orchard Harbor, N. Y., improvement of	347			2270

Subject.	Page. Part I.		Part II.	Part III.
Ocmulgee River, Ga., improvement of	199		1295	
Oconee River, Upper, Ga., from Skull Shoals to the Georgia railroad bridge, examination and survey of	207		1329	
Oconee River, Ga., improvement of	200		1297	
Oconto Harbor, Wis., improvement of	300			1982
Office of the Chief of Engineers	378			
Officers of the Corps of Engineers, number of, duties of	3	379		
Ogdensburg Harbor, N. Y., improvement of	353			2293
Ohio River, construction of ice-harbor near Cincinnati	284			1825
Ohio River, Davis Island lock and dam	280	281		1784, 1802
Ohio River, examination and survey of bar opposite mouth of Licking River	285			1843
Ohio River, improvement of	280			1776
Ohio River, improvement of falls of	282			1811
Ohio River at Jeffersonville, Ind., construction of levee at	281			1796
Olcott Harbor, N. Y., improvement of	347			2269
Old Town Creek, Miss., improvement of	210		1355	
Old River Bed, Cuyahoga River, at Cleveland, Ohio, examination on the opening of the channel known as	344			2249
Olympia Harbor, Wash., examination and survey of	369			2413
Ontonagon Harbor, Mich., improvement of	296			1968
Oostenaula River, Ga., improvement of	201		1300	
Osage River, Mo., examination of, from mouth to Linn Creek, with view to movable locks and dams	259		1657	
Osage River, Mo. and Kans., improvement of	254		1636	
Oswego Harbor, N. Y., improvement of	350			2278
Otter Creek, Vt., improvement of	356			2309
Ouachita River, La. and Ark., improvement of	234		1497	
Owensboro', Ky., examination of harbor at	284			1831
Owl's Head Harbor, Me., examination and survey of southern entrance to	60	476		
P.				
Paducah, Ky., examination of harbor at	284			1830
Pamplico River, N. C., improvement of	161		1041	
Pamunky River, Va., improvement of	148		982	
Pascagoula River, Miss., improvement of	211		1358	
Pascagoula River, Miss., from Moss Point to anchorage in bay, examination and survey of	214			
Pasquotank River, N. C., above mouth of canal, examination of	164		1049	
Passaic River, N. J., above Newark, improvement of	102	744		
Passaic River, N. J., below Newark, improvement of	103	746		
Pass Cavallo Inlet, Tex., improvement of	228		1462	
Patapsco River, Md., improvement of	137		917	
Pawcatuck River, R. I., examination and survey of	80	622		
Pawtucket River, R. I., improvement of	73	592		
Pearl River, Miss., improvement of, between Edinburg and Carthage	213		1371	
Pearl River, Miss., improvement of, below Jackson	212		1363	
Pearl River, Miss., improvement of, from Jackson to Carthage	213		1369	
Pease Creek, Fla., improvement of	196		1268	
Pee Dee River, Great, S. C., improvement of	172		1100	
Penobscot River, Me., defenses of	7			
Penobscot River, Me., improvement of	55	464		
Pensacola Harbor, Fla., defenses of	39			
Pensacola Harbor, Fla., examination and survey of outer and inner bar at entrance of	207		1316	
Pensacola Harbor, Fla., improvement of	206		1313	
Pensaukee Harbor, Mich., improvement of	301			1985

Subject.	Page. Part I.		Part II.	Part III.
Pentwater Harbor, Mich., improvement of	318			2075
Perquimans River, above Hartfort, N. C., examination of	164		1045	
Petaluma Creek, Cal., improvement of	359			2339
Petit Jean River, Ark., examination and survey of	252		1627	
Philadelphia, Pa., defenses of	25			
Pier at Lewes, Del., construction of	121	845		
Pierre Bayou, La., survey of	232		1487	
Pierre Bayou, Miss., examination of	226		1439	
Pilgrim Rock, East River, N. Y., removal of	97	733		
Pine River, Saint Clair County, Mich., examination of	332			2183
Plattsburg Harbor, N. Y., improvement of	355			2306
Plaquimine Bayou, La., examination of	225		1431	
Plymouth Harbor, Mass., examination of a channel from Goose Point to the Cordage Company's wharf	67	538		
Plymouth Harbor, Mass., improvement of	64	510		
Pocomoke River and Sound, Md., examination and survey of	137	904		
Portage Lake and Lake Superior Ship-Canal, Mich., purchase of	331			2170
Portage Lake, Mich., construction of harbor of refuge at	316			2069
Port Chester, Harbor, N. Y., improvement of	87	658		
Port Clinton Harbor, Ohio, improvement of	334			2215
Port Jefferson Harbor, L. I., N. Y., improvement of	90	665		
Portland Harbor, Me., defenses of	8			
Portland Harbor, Me., improvement of	58	469		
Portsmouth Harbor, N. H., defenses of	10			
Portsmouth Harbor, N. H., examination of, from the sea to the wharf	60	478		
Portsmouth Harbor, N. H., examination of Little Harbor at, for a harbor of refuge	60	480		
Portsmouth Harbor, N. H., improvement of	58	472		
Port-warden's line at Philadelphia	126	857		
Port Washington Harbor, Wis., improvement of	306			2003
Post and depot at Willets Point	53	457		
Potomac River, improvement of, in vicinity of Washington, D. C.	140		926	
Potomac River, fish-ways at Great Falls of	374			2499
Potomac River, at Mount Vernon	144		962	
Powow River, Mass., examination and survey of	67	549		
Providence River, R. I., improvement of	73	596		
Provincetown Harbor, Mass., improvement of	64	513		
Public buildings and grounds, District of Columbia	374			2503
Pultneyville Harbor, N. Y., improvement of	349			2273
Puyallup River, Wash., examination and survey of	369			2417
Q.				
Quincy Bay, Ill., examination and survey of bar and obstructions at mouth of Whipple Creek in	266			1717
Quincy Bay, Ill., improvement of	265			1709
R.				
Raccoon River, N. J., improvement of	124	851		
Racine Harbor, Wis., improvement of	308			2019
Rahway River, N. J., improvement of	106	753		
Rancocas River, N. J., improvement of	123	849		
Rank and duties, officers of Engineers	379			
Rappahannock River, Va., improvement of	146		971	
Raritan Bay, N. J., improvement of	108	757		
Raritan River, N. J., improvement of	109	759		
Reconnaissances and explorations	376			

Subject.	Page.		
	Part I.	Part II.	Part III.
Red River above Fulton, Ark., examination and survey of	252	1617	
Red River, La., improvement of	230	1472	
Red River, Little, Ark., examination and survey of	252	1612	
Red River of the North, improvement of	270		1742
Red River of the North, construction of lock and dam at Goose Rapids	271		1745
Redwood Harbor, Cal., improvement of	358		2338
Reservoirs at sources of the Mississippi River and its tributaries, construction of	272		1747
Reservoirs at sources of the Mississippi River and its tributaries, surveys for	273		1750
Rio Grande, Tex., protection of river banks at Fort Brown	230	1470	
River and harbor improvements	53		
Roanoke River, N. C., improvement of	152	995	
Rock Island Harbor, Mississippi River, improvement at	263		1695
Rock Island Rapids, Mississippi River, improvement at	263		1694
Rockland Harbor, Me., improvement of	57	467	
Rocky River Harbor, Ohio, improvement of	339		2227
Romerly Marsh, Ga., improvement of water-route through	186	1215	
Rondout Harbor, N. Y., improvement of	94	697	
Rough River, Ky., examination and survey of	292		1893
Rouse's Point, N. Y., construction of breakwater at	354		2297
S.			
Sabine Pass, Tex., improvement of	223	1415	
Sabine River, Tex., improvement of	224	1425	
Sackett's Harbor, N. Y., improvement of	352		2282
Saco River, Me., examination and survey of, and breakwater at mouth of	58	60	
Sacramento River, Cal., improvement of	362		2360
Saginaw River, Mich., improvement of	327		2138
Saint Anthony, preservation of Falls of	266		1721
Saint Augustine Creek, Ga., improvement of	186	1214	
Saint Augustine, Fla., defenses of	38		
Saint Augustine Harbor, Fla., examination of	199	1282	
Saint Clair Flats Ship-canal, Mich., repairs of	329		2159, 2160
Saint Clair Flats Ship-canal, Mich., operating and care of	330		2161
Saint Clair River, Mich., examination and survey of, near Saint Clair Flats Canal	332		2197
Saint Croix River, Wis. and Minn., improvement of	269		1738
Saint Francis River, Ark., improvement of	249	1595	
Saint Francis and White rivers, Ark, improvement of	249	1594	
Saint Jerome's Creek, Md., improvement of harbor at	146	968	
Saint John's River and Fernandina, Fla., deepening inside passage between	191	1234	
Saint John's River, Fla., examination for inland communication from the, through Mosquito Lagoon and Indian River to Jupiter Inlet and Lake Worth, Fla	199	1291	
Saint John's River, Fla., improvement of bar at mouth of	191	1243	
Saint John's River, Fla., Upper, improvement of	193	1253	
Saint Jones River, Del., improvement of	129	877	
Saint Joseph's Harbor, Mich., improvement of	321		2086
Saint Joseph's River, Idaho, examination of	372		2442
Saint Louis Bay and River, Minn., to foot of first falls, examination and survey of	296		1959

Subject.	Page.			
	Part I.		Part II.	Part III.
Saint Louis, Mo., improvement of Mississippi River opposite	259		1656	
Saint Louis River, Minn. and Wis., construction of bridge of Northern Pacific Railroad Company across.	293			1925
Saint Mary's Falls Canal and Saint Mary's River, Mich., improvement of	325			2104
Saint Mary's Falls Canal, Mich., dry-dock at	326	332		2124, 2186
Saint Mary's Falls Canal, Mich., operating canal at	325			2108
Saint Mary's River, Mich., improvement of Hay Lake Channel	324			2098
Salem, Mass., examination of harbor at, with view to building a jetty	67	537		
Salem River, N. J., examination of mouth of	127	860		
Salem River, N. J., improvement of	124	852		
Saline River, Ark., improvement of	250		1598	
Salkiehatchie River, S. C., improvement of	182		1192	
Salmon River at and below Fort Covington, N. Y., examination and survey of	352			2286
Salmon River, mouth of, and the inner natural harbor thereat on Lake Ontario, N. Y., examination and survey for harbor of refuge	352			2291
Sand Beach, Mich., Lake Huron, harbor of refuge at	328			2151
San Diego, Cal., defenses of	45			
San Diego Harbor, Cal., improvement of	360			2349
Sandusky City Harbor, Ohio, improvement of	335			2216
Sandusky River, Ohio, improvement of	337			2218
Sandy Bay, Cape Ann, Mass., harbor of refuge at	66	520		
San Francisco, Cal., defenses of	45			
San Francisco Bay, Cal., examination and survey of Islias Creek	360			2340
San Francisco Harbor, Cal., removal of wreck from	359			2339
San Joaquin River, Cal., improvement of	361			2353
San Joaquin River, Cal., removal of wreck from	360			2339
San Mateo River, Cal., examination of	360			2342
Santee River, S. C., improvement of	175		1119	
Saranac River, N. Y., examination and survey of mouth of, at Plattsburgh	357			2318
Sassafras River, above Georgetown, Md., examination and survey of	137	914		
Saugatuck Harbor, Mich., improvement of	321			2084
Saugerties Harbor, N. Y., improvement of	95	699		
Savannah, Ga., defenses of	36			
Savannah River and Harbor, Ga., improvement of	182		1195	
Savannah River, Ga., above Augusta, improvement of.	185		1213	
Savannah River, Ga., below Augusta, improvement of.	184		1207	
Scajacuanda Creek, at Buffalo, N. Y., examination and survey of	352			2283
School of application, Battalion of Engineers	52	427		
Schuylkill River, Pa., improvement of	119	837		
Scituate Harbor, Mass., improvement of	62	501		
Scioto River, Ohio, examination and survey of	285			1832
Scuppernong River, N. C., improvement of	163		1044	
Scuppernong River, N. C., removal of wreck from	164		1044	
Sea-coast and lake frontier defenses, general remarks on and estimates for	4			
Shawneetown Harbor and Levee, Ill., examination of.	284			1828
Sheboygan Harbor, Wis., improvement of	305			2001
Sheepshead Bay, N. Y., improvement of	99	740		
Shenandoah River, Va. and W. Va., improvement of	143		957	
Shrewsbury River, N. J., improvement of	105	751		
Skaget River, Wash., improvement of	367			2403
Skipton Creek, Md., examination of	137	907		
Snag-boats on the Arkansas, operations of	244		1558	

Subject.	Page. Part I.		Part II.	Part III.
Snag-boats on the Lower Mississippi and Missouri, operations of	252	253	1633, 1634 1652, 1653	
Snag-boats on the Upper Mississippi, operations of	260	265		1662, 1710
Snake River, Idaho, between Lewiston and mouth of Boise River, examination of	372			2440
Snake River, Wash., improvement of	370			2437
Snohomish River, Wash., improvement of	367			2403
Snoqualmie River, Wash., improvement of	367			2403
Sny Island Levee, Mississippi River, examination of	266			1710
Sodus Harbor, N. Y., Great, improvement of	349			2274
Sodus Harbor, N. Y., Little, improvement of	350			2276
South Forked Deer River, Tenn., improvement of	242		1529	
South Haven Harbor, Mich., improvement of	321			2085
South Pass, Mississippi River, inspection of improvement at	214		1377	
Southport Harbor, Conn., improvement of	86	655		
South River, N. J., improvement of	112	764		
Staten Island, N. Y., improvement of New Jersey Channel	104	749		
Staunton River, Va., improvement of	150	151	989, 992	
Steele's Bayou, Miss., improvement of	241		1522	
Steilaquamish River, Wash., improvement of	367			2403
Stockholm, Wis., construction of harbor of refuge at	262			1687
Stonington Harbor, Conn., improvement of	78	616		
Sturgeon Bay Canal, Wis., harbor of refuge at	302			1988
Sumpawanus Inlet, L. I., N. Y., improvement of	100	742		
Sunflower River, Miss., improvement of	238		1511	
Superior Bay, Wis., improvement of	294			1944
Survey of Northern and Northwestern lakes, issue of charts of	375			2519
Surveys and examinations for improvement of rivers and harbors, estimates for	372			
Surveys and explorations west of one hundreth meridian	376			
Surveys for Hennepin Canal	314			2056
Susquehanna River, Pa., West Branch of the, between Salt Lick and Buttermilk Falls, examination of	127	864		
Susquehanna River, Pa., improvement of North Branch of	125	854		
Susquehanna River, near Havre de Grace, Md., improvement of	131	882		
Suwanee River, Fla., improvement of	195		1265	
Swanton, Vt., examination and survey of Maquam Bay	357			2321
Swanton Harbor, Vt., improvement of	354			2305
T.				
Tallahatchie River, Miss., improvement of	239		1517	
Tallapoosa River, Ala., improvement of	203		1307	
Tampa Bay, Fla., improvement of	194		1262	
Tampa Bay, Fla., removal of wreck from	199		1279	
Tangipahoa River, La., improvement of	215		1393	
Tar River, N. C., improvement of	161		1041	
Taunton River, Mass., improvement of	71	588		
Tchefuncte River, La., improvement of	216		1394	
Tchula Lake, Miss., improvement of	238		1514	
Teche, Bayou, La., connection with Grand Lake, at Charenton	218		1399	
Teche, Bayou, La., improvement of	217		1397	
Teche, Bayou, La., removal of wrecks from	225		1428	
Tennessee River, above Chattanooga, improvement of	273			1751
Tennessee River, below Chattanooga, improvement of	274			1753
Tennessee River, Little, improvement of	278			1769
Tensas River, La., improvement of	236		1504	

Subject.	Page. Part I.		Part II.	Part III.
Terrebonne, Bayou, La., improvement of	221		1407	
Tickfaw River, La., improvement of	217		1396	
Thames River, Conn., improvement of	81	638		
Thunder Bay Harbor, Mich., improvement of	327			2129
Thunderbolt River, Ga., improvement of	186		1214	
Ticonderoga River, N. Y., improvement of	356			2309
Toledo Harbor, Ohio, improvement of	333			2211
Tombigbee River, Ala., improvement of	209		1349	
Torpedo defense	50			
Totusky River, Va., improvement of	147		976	
Townshend Inlet, N. J., examination of	126	858		
Tradewater River, Ky., improvement of	289			1883
Trent River, N. C., improvement of	165		1062	
Trinity River, Tex., improvement of	227		1455	
Tuckahoe Creek, Md., examination and survey of	137	908		
Turrets and armor-plates, &c., information in relation thereto	421			
Two Rivers, Harbor, Wis., improvement of	304			1995
U.				
Upper Columbia and Snake rivers, Oreg. and Wash., improvements of	370			2437
Upper Mississippi River, operations of snag-boats on	260			1662
Upper Oconee River, Ga., from Skull Shoals to the Georgia railroad bridge, examination and survey of	207		1329	
Upper Saint John's River, Fla., improvement of	193		1253	
Upper Thoroughfare, Deal's Island, and mainland, Md., improvement of	136	889		
Upper Willamette River, Oreg., improvement of	369			2424
Urbana Creek, Va., improvement of	148		977	
V.				
Vermillion Harbor, Ohio, improvement of	338			2222
Volusia Bar, Lake George, Fla., improvement of	193		1254	
W.				
Wabash River, Ind., from Logansport to Delphi, examination of	257		1649	
Wabash River, Ind., improvement of	255		1638	
Waccamaw River, N. C., improvement of	173		1105	
Wachita River, Ark. and La., improvement of	234		1497	
Wacissa River, Fla., examination and survey of	214			
Wappoo Cut, S. C., improvement of	179		1186	
Wareham Harbor, Mass., improvement of	70	585		
Warren River, R. I., examination and survey of	80	625		
Warrior River, Ala., improvement of	208		1345	
Washington Aqueduct, D. C	372			2453
Washington, D. C., defenses of	29			
Washington and Georgetown harbors, D. C., improvement of	139		923	
Washington, D. C., improvement of Potomac River at	140		926	
Washington, D. C., increasing water supply of	373			2469
Wateree River, S. C., improvement of	176		1123	
Water gauges on Mississippi River and its tributaries	243		1532	
Water gauges on Columbia River, Oreg., and tributaries	368			2408
Waukegan Harbor, Ill., improvement of	309			2023
Wekeiva River, Fla., examination of	199		1281	
Whipple Creek, Quincy Bay, Ill., examination at	266			1717
White and Saint Francis rivers, Ark., improvement of	249		1594	
Whitehall Harbor, N. Y., examination and survey of	357			2310

Subject.	Page. Part I.		Part II.	Part III.
White River, Ark., improvement of	248		1586	
White River, Ark., above Buffalo Shoals, improvement of	248		1591	
White River, between Jacksonport and Buffalo Shoals, Ark., improvement of	249		1593	
White River Harbor, Mich., improvement of	318			2076
White River, Ind., improvement of	257		1642	
Wicomico River, Md., improvement of	136	888		
Willamette River, Lower, Oreg., improvement of	364			2376
Willamette River, construction of bridge across, at Portland	293			1917
Willamette River, Upper, Oreg., improvement of	369			2424
Willapah River, Wash., examination and survey of	369			2420
Willets Point, N. Y., engineer post and depot at	53	457		
Wilmington Harbor, Cal., improvement of	358			2333
Wilmington Harbor, Del., improvement of	127	869		
Wilmington, N. C., defenses of	34			
Wilson Harbor, N. Y., improvement of	346			2268
Winnipeseogee Lake at a point called "The Weirs," N. H., examination of	60	479		
Winyaw Bay, entrance to, near Georgetown, S. C., examination and survey of	177		1154	
Wisconsin and Fox rivers, improvement of	310			2025
Withlacoochee River, Fla., improvement of	198		1277	
Wolf Lake, Ind., examination of	314			2056
Woodbridge Creek, N. J., improvement of	107	754		
Woodbury Creek, N. J., improvement of	123	850		
Wood's Holl Harbor, Mass., improvement of	69	580		
Wood Island Harbor, Me., examination and survey of	60	489		
Wrecks in Chesapeake Bay, removal of	137	890		
Wrecks in Delaware Bay and River, removal of	126	855		
Wrecks off Little Egg Harbor, N. J., removal of	126	856		
Wrecks in New Haven Harbor, Conn., removal of	95	700		
Wrecks in New York Harbor endangering navigation, removal of	114	787		
Wrecks in New Orleans Harbor, La., removal of	225		1427	
Wreck in San Francisco Harbor, Cal., removal of	359			2339
Wreck in San Joaquin River, Cal., removal of	360			2339
Wreck in Scuppernong River, N. C., removal of	164		1044	
Wreck in Tampa Bay, Fla., removal of	199		1279	
Wrecks in Teche Bayou, La., removal of	225		1428	
Y.				
Yadkin River, N. C., improvement of	162		1042	
Yallabusha River, Miss., improvement of	240		1519	
Yaquina Bay, Oreg., improvement of entrance to	365			2393
Yazoo Pass, Miss., to determine the cost of a lock, examination at	243		1537	
Yazoo River, Miss., improvement of	237		1507	
Yellowstone River, improvement of	259		1659	
York Harbor, Me., examination and survey of	60	485		
York River, Va., improvement of	149		984	
Yuba River, Cal., examination of	363			2373

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